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A NOVEL METHOD OF BRIDGE ERECTION is to be adopted in building the channel spans of the Baltimore & Ohio R. R. Co.'s bridge across the Ohio River at Benwood, W. Va. The longest of these spans is 350 ft. The Government would not allow any obstruction to be placed in the channel. Under these conditions a very difficult proposition has to be considered and the scheme now adopted for the erection possesses some novel features in bridge engineering. The adjoining new span will be used as one of the anchor spans and temporary trusses will be constructed on the other adjacent span and used as one of the cantilever arms for the central span, so the latter can be erected on the cantilever principle from each end. There will be no falsework under this span and during the erection of the bridge navigation will be uninterrupted and railroad traffic will not be diverted from the old structure. With the renewal of these spans the entire bridge will be rebuilt from end to end. The approach spans have been reconstructed within the last two years by the American Bridge Co., so when the two spans now referred to are in place, the entire bridge, consisting of some 15 spans, will have a capacity to sustain the heaviest loads carried by modern up-to-date trains. The total length of bridge is about 2,416 ft.

A CONCRETE-STEEL ARCH BRIDGE, consisting of three 100-ft. spans, is under construction over the Des Moines River at North Sixth St., Des Moines, Ia. The total length of the bridge is 398 ft., and it is 42 ft. wide between railings. The spandrel walls and arch-ring faces will be faced with brick. The cost of the bridge proper will be $74,900.

THE LONG PLANNED INTERNATIONAL BRIDGE over the Detroit River to obviate the present car ferries is again under consideration by the railways centering at that point. Mr. Geo. S. Morison, M. Am. Soc. C. E., has been retained by the railways as engineer and has, it is stated, already begun the studies for the proposed bridge.

THE ST. LAWRENCE CANALS opened on May 1 and 24 steamers and barges were waiting at the head of the Long Sault to make the passage. On the barges were 600,000 bushels of grain for export and several thousand tons of coal consigned to Montreal. No such rush of traffic at the opening of navigation has ever been recorded on the St. Lawrence.

ANOTHER 2,000-HP. STEAM TURBINE is being built for the Hartford Electric Light Co., of Hartford, Conn., by the Westinghouse Machine Co., of Pittsburg, Pa. One such machine was installed in the same plant about a year ago, and this duplicate order is to be taken to indicate the success of the first installation. The Westinghouse Machine Co. informs us that the steam turbines (Westinghouse-Parsons) which they have either completed, are now building, or have orders for, aggregate nearly 200,000 KW.

THE ORDERS FOR STEEL RAILS have been so great that it is estimated that 500,000 tons, calling for delivery this year, will be carried over into next year. Street railways are largely responsible for the increased consumption of steel rails. Many consumers are holding off, hoping for a reduction in price.

THE MOST SERIOUS RAILWAY ACCIDENT of the week occurred on the Canadian Pacific Ry. at Dexter, near Port Arthur, Ont., on May 7. A work train was run into by a passenger train and the caboose in which were a large number of laborers was overturned and burned up. Twelve men were killed. Another wreck more serious than we usually have to report occurred on the New York Central & Hudson River R. R. at Nelson Lake, N. Y., on May 9. Two passenger trains running in opposite directions came together because one of them had run past his meeting point, and four of the trainmen were killed.

THE ITHACA TYPHOID EPIDEMIC, according to a report by Mr. Geo. A. Soper, Assoc. M. Am. Soc. C. E., had numbered 935 cases and 64 deaths up to May 7. Of the deaths, 29 were students of Cornell University. Mr. Soper is assisting the State Board of Health of New York.

ELECTROLYSIS OF WATER PIPE at St. Louis, Mo., according to the last annual report of Mr. Edward Flad, M. Am. Soc. C. E., Water Commissioner, is eating away 61 tons of mains and services yearly. Electrical surveys have recently been made by Mr. E. E. Brownell.

FROM CHICAGO TO ST. LOUIS in 10 days, 6 hours, and 3 minutes is the record for sewage traversing the Chicago Drainage Canal, Des Plaines, Illinois, and Mississippi Rivers, according to testimony in the St. Louis-Chicago suit, credited to Prof. J. L. Van Ornum, M. Am. Soc. C. E., of Washington University, St. Louis. It appears that the float experiments on this subject have been made, but that the rivers were above the normal at the time.

MANY IRRIGATION CANALS are under way or projected in California and Wyoming. According to "Forestry and Irrigation," one transaction involving $500,000 and 30,000 acres of ground is the result of merging the interests of the Artesian Water Co., the Santa Monica Water Co., the Water Company of Sawtelle and a number of individuals at and near Los Angeles, California. The purpose is to furnish water for irrigation and domestic uses to all of the Pacific Coast area from Los Angeles to the sea, including the supplying of city water to Santa Monica and Playa del Rey.

Another California venture provides for what is termed the most extensive irrigation canal project in the State of California, contracts having been let for the completion of a canal which will extend from the northern boundary of Glenn county to the southern border of Colusa, watering one of the richest sections of the state, through a distance of 85 miles.

The Butte County Canal Co., in the same state, will divert the waters of the Feather River to cover 180,000 acres in Butte county in the neighborhood of Oroville, Biggs, Gridley, and Liveoak. Articles of incorporation for the company have been filed, and plans look toward a 15-mile main canal, with 6-ft. bottom and a combined length of nearly 200 miles in main and lateral ditches. It is promised that the rate per acre for water will be the lowest in the state.

Not less than six irrigation projects are under way in Wyoming, some of them of considerable importance. The Boulder Creek Canal Co., in Fremont county, intends to reclaim by irrigation 7,000 acres of land with water from Boulder Creek, about 20 miles north of New Fork. The Encampment-Platte Valley Ditch Co. has been organized at Saratoga, Wyo., to construct a 9-mile canal from the Encampment River to cover 1,100 acres of land on the west side of the Platte. Omaha (Neb.) capital is being interested in a plan for a large canal to take water from the Big Horn River, 50 miles south of Basin City, Wyo. It is proposed to cover all the land known as Gooseberry Flat, comprising many thousands of acres of fertile soil. The Big Horn Canal Co. has built its main canal from the Big Horn River to Fifteen-mile Creek, a distance of 15 miles. Here a tunnel will be necessary before further progress can be made. All of the land under the present ditch has been filed upon by a colony from Indiana.

The Big Horn Basin Development Co. will reclaim 250,000 acres of land in the neighborhood of Guernsey under the provisions of the Carey act, and will construct a canal 80 miles long, with a storage reservoir to hold 20,000,000,000 cu. ft. of water.

Contracts have been let for damming the Snake River in Idaho at a point 65 miles above Shoshone Falls and building 65 miles of canal on the south and 24 miles on the north side of the river, not including laterals, which will irrigate 340,000 acres under the new government irrigation law. The dam will cost $400,000 and the main canals $2,500,000. The latter will be 80 ft. wide at the bottom, 160 ft. at the top and will carry 10 ft. of water, raised 40 ft. from the river.

A DECISION IN THE PEORIA GAS RATE CASE, adverse to the city, has been rendered by I. C. Pinckney, Special Master in Chancery, who was appointed to investigate the subject for the U. S. Courts. On Sept. 4, 1900, the city council of Peoria, Ill., passed an ordinance fixing the price of gas supplied in Peoria at 75 cts. per 1,000 cu. ft. A summary of the findings of the Master is as follows:

(1) That the exercise of the right claimed by the city must be reasonable; (2) that the question of reasonableness of such a right is for judicial determination—that is, that neither the city nor the legislature of the State itself has the right to fix a rate in such a manner that the courts cannot inquire into its reasonableness; (3) that in determining the cost of the manufacture and distribution of gas the depreciation of the plant and a reasonable interest on the money invested are proper elements of such cost; (4) that a federal question is clearly involved because under the facts in evidence the enforcement of the ordinance would necessarily amount to a taking of the complainant's property without due process of law.

THE NEW YORK FRANCHISE TAX LAW was recently sustained in all respects by a unanimous decision of the New York State Court of Appeals. It is stated that an appeal to the U. S. Supreme Court will be taken. The law, in effect, declared franchises for the use of public streets real estate, and taxable as such. The act as originally drafted did not go beyond this, but numerous amendments were made, including one vesting the assessments of franchises in the hands of a State Board of Appraisers, instead of in local boards. One of the local courts held that this was a violation of the constitutional provision for home rule in matters of taxation.

MUNICIPAL OWNERSHIP OF STREET RAILWAYS in Illinois has been decidedly victorious after a hard and, at times, unseemly struggle in the State legislature. The bill was drawn largely, if not wholly, in the interests of the city of Chicago, to enable it to cope with the local street railway companies, but it applies to any city in the State. The bill authorizes the city to construct, buy, and operate street railways, or to lease them to private companies for not more than 20 years, provided such action shall be approved by popular vote.

THE EDISON GOLD SEPARATOR is described in a sketchy article by Cloyd M. Chapman in a recent issue of "The Engineering and Mining Journal." The process, as stated in our issue of May 7, consists in sizing the placer gravel by screens and then treating each size in a "separator," where a blast of air removes the lighter tailings. Gravel over ⅛-in. in size is not treated, and in one test of efficiency of the "separators" it is stated that 92.5% of the gold was saved.

EVEN PILE PULLING IS PROFITABLE in California, according to recent newspaper reports, for in pulling one of the soft pine piles on "the Clark roalroad" it is said that "several good-sized nuggets were found embedded in the end of the pile." This was in the Mojave desert near The Needles, and the pile-driving crew suddenly quit piling for panning. Last week we chronicled the hydraulicking of broken stone into a macadam road in California. This week it is pulling gold with piles. Next?

A MINING SHAFT THROUGH QUICKSAND is being sunk by means of a novel process for the Minnesota Iron Co. near Chisholm on the Mesaba Range. The method of sinking is one patented by Captain Hoar of Negaunee, Mich., and is described as follows: Two heavy sets or shaft frames cased on the outer side with steel are started and outside of them long steel lined lath are sunk downward. These lath fit reasonably tight and can be driven and jacked down independently of each other so that when obstructions are met they may be surrounded. The sand and other material inside these lath are taken out and the sets within are driven down. The process is repeated to the bottom. The shaft is being sunk at the rate of 2 ft. per day and the depth to rock is 90 ft.

THE LARGEST OVERSHOT WATERWHEEL still in existence is said to be that at the Great Laxey Mine on the Isle of Man. According to a description in London "Engineering" of May 1, this wheel is 72 ft. in diameter and capable of developing about 200 HP. It has for many years driven the pumps for draining the mine; but in the extension of the workings a greater quantity of water was met than the pumps could handle and the mine has been flooded to a total depts of about 1,000 ft. A temporary steam pumping plant is now to be installed to unwater the mine and later a permanent electrical pumping plant will be installed.

THE CENTER SQUARE WATER-WORKS OF PHILADELPHIA; THE SOURCE OF WATER SUPPLY FROM 1801 TO 1815.

The centennial of the first introduction of a public water supply into the city of Philadelphia occurred in 1901; and while some of the material here used in describing this early American plant

VIEW OF THE CENTER SQUARE PUMPING STATION, PHILADELPHIA, ON THE SITE OF THE PRESENT PUBLIC BUILDINGS. OPERATED FROM JAN. 21, 1801, TO SEPT. 7, 1815. BUILDING TORN DOWN IN 1827.

(Reproduced from an old print.)

was published in Engineering News in 1887, it will be novel to the great majority of our present readers. The sectional view of the Center Square engine house and those of the wooden and cast-iron boilers originally employed at that station were made by the late Frederic Graff, Past President of the American Society of Civil Engineers, from data found among the papers of Frederic Graff, Sr., the draftsman for the engineer of the works described. The elder Graff later became superintendent of the Philadelphia water-works and held that position for 42 years. He was intimately connected with the water supply of that city from 1799 until 1847.

The early history of the Philadelphia water supply may be briefly sketched as follows: In 1798-99 various measures of municipal improvement were set on foot, and among these was one for providing the city with an adequate public water supply. In 1798, the Spring Mill Creek, in Montgomery Co., Pa., 12 miles from Philadelphia, had been strongly urged as a good source of supply; but an appeal to the citizens of Philadelphia for money for this purpose was made in vain. In December, 1798, the citizens, the managers of the marine and city hospitals and the Delaware & Schuylkill Canal Co. united in a petition to the Pennsylvania Legislature asking for State aid in obtaining a water supply. The Senate appointed a committee to investigate the matter, and on Jan 12, 1799, this committee reported favorably and recommended the completion of the Delaware & Schuylkill Canal as one of the most feasible methods of bringing water to the city. It was proposed that the State purchase $200,000 of the proposed water loan, and raise the money for this purpose by mortgaging the house built in Philadelphia for the use of the President of the United States, and by imposing a tax upon auction sales; but no definite action was taken.

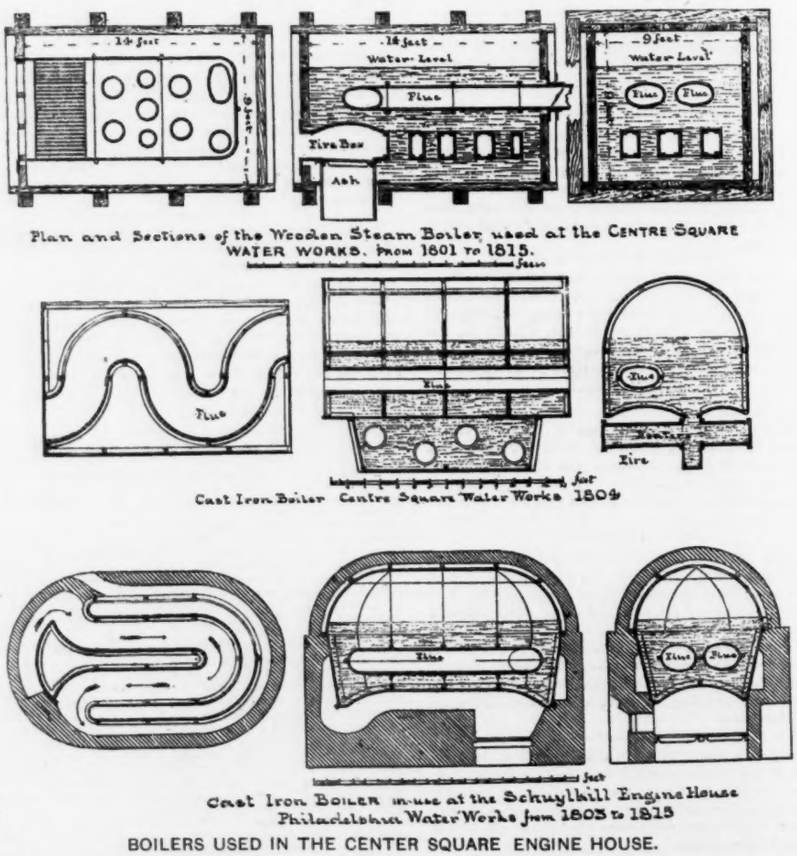
Mr. Benjamin H. Latrobe was appointed engineer for the proposed works by the city authorities; and he reported upon the Spring Mill Creek project first by saying that the water might be brought to the city in a closed 3-ft. 6-in. elliptical conduit, 12 miles long, for $275,000. He urged instead of this plan another, by which water was to be pumped by steam power directly from the Schuylkill River to a reservoir located in the city; the latter to be high enough to distribute the water by gravity. The canal company vigorously opposed this latter scheme, and advocated the completion of their canal to Center Square—the site of the present Public Buildings of Philadelphia. They claimed that the water could thus be brought to the edge of the then city by gravity and delivered at a point 40 ft. above high water in the Delaware River. This water was then to be distributed in open canals along every street, depending upon its volume for its general purity.

There was much opposition to Latrobe's proposed pumping by steam, and Mr. Latrobe, in defending his plan in 1801, admitted that the only steam engines of any considerable power then at work in the United States were those of the Manhattan Water Co., in New York; one used by Mr. Roosevelt in New York to saw timber; another driving a rolling and slitting mill, and one in Boston, of which he was only "generally informed."

Under these conditions it is not so strange that the Philadelphia "Gazette," of July 31, 1800, assailed his plan as "a ridiculous project," and expressed the hope that the people of the city would not be duped by such chimeras, but would turn out of the city councils all the men advocating pumping water by steam. The "Gazette" believed that such a plant would be a "public nuisance," costing an unheard-of sum of money, and would be "the probable cause of a great public calamity." This journal remarked, in support of its argument, that "steam engines are machines of all machinery the least to be relied upon, and were especially unreliable for a proper supply of water."

The plan of Mr. Latrobe was adopted, nevertheless, and in February, 1799, the city councils authorized a water loan of $150,000; and for the payment of interest and final redemption of this loan they pledged all the estates and property of the corporation, excepting only the High Street Bridge and Ferry. Water was to be freely distributed to street hydrants; and for each share of the loan subscribed one dwelling house was to be supplied with water for three years gratuitously. As the amount thus raised was not sufficient a further amount of $50,000 was raised later by direct taxation.

The plan as formulated by Mr. Latrobe was as follows: On the Schuylkill River, on the upper side of Chestnut St., an inlet was to be built, 200 ft. long, 84 ft. wide and with its bottom 3 ft. below low-water mark. From this inlet an open channel, 160 ft. long, led to the foot of the hill on Chestnut St., and then a tunnel, 6 ft. diameter and 360 ft. long, was driven through the rock to a well, 10 ft. diameter and 52 ft. deep. At this well a steam engine was to lift the water to a 6-ft. brick tunnel, 3,144 ft. long, leading up Chestnut to Broad St., and up Broad to the middle of Center Square,


14 feet
9 feet
Water Level
Flue
Fire Box
Ash
Plan and Sections of the Wooden Steam Boiler used at the CENTRE SQUARE WATER WORKS. from 1801 to 1815.
Cast Iron Boiler Centre Square Water Works 1804
Cast Iron Boiler in use at the Schuylkill Engine House Philadelphia Water Works from 1805 to 1815

BOILERS USED IN THE CENTER SQUARE ENGINE HOUSE.

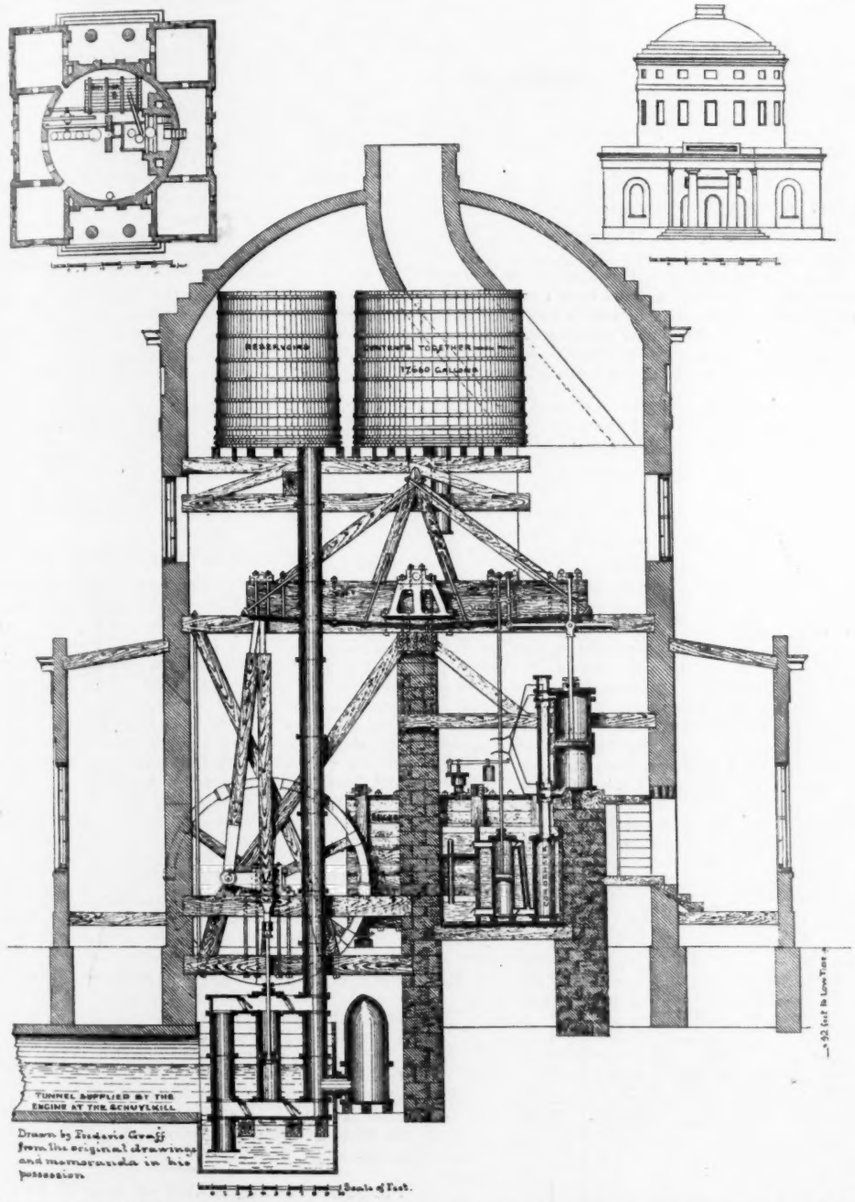
where the water was to be raised 51 ft. by a steam engine to reservoirs holding 17,000 gallons. The water descended from these reservoirs to a 4 × 8-ft. iron chest outside the building; and from this

chest the distributing pipes were led through the city.

On March 12, 1799, the ground was broken in Chestnut St. for the upper tunnel; on May 1 contracts were made for boring the logs for the distribution pipes; on June 1 the first pipes were buried and the foundations laid for the lower pumping station. In February, 1800, the engine at Center Square was commenced; and on Jan. 21, 1801, the Center Square engine was started and water was delivered to the distribution system. These works continued to supply the city with water until Sept. 7, 1815, when they were superseded by the Fairmount Water-Works. The report of the Water Committee in 1801 showed that $220,310 had been expended and more money was needed. In that year 63 houses, four breweries and one sugar refinery had been supplied with water; and 37 public hydrants had been set up. The rate for the dwellings of "non-subscribers" was $5 per annum.

Several plans were adopted for distribution. "Cistern pumps" were placed in the streets, in which the wooden cistern was located below the street line and connected with the distribution pipes, and the water had to be pumped out. Other pipes, carrying water under the reservoir pressure, connected with upright pipes, called hydrants, which were closed by a cap and to these hose could be attached in case of fire; these upright pipes were covered by a wooden box and were later known as fire-plugs. The waste of public water was apparent as early as 1801; and in May 23, 1801, a fine of $1 was imposed for needlessly opening or allowing to remain open any device connected with the water distribution. As this small fine seemed to have no effect, in 1804 the fine was increased to $50 for wantonly wasting water; though this was reduced to $5 in 1806.

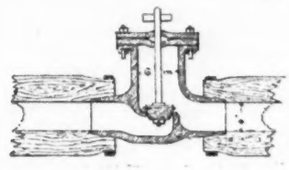
The water pipe generally used until 1819 was a bored spruce-pine log, bound with iron bands at the ends. The stop employed with these log pipes until 1844 is shown in the accompanying illustration. It may be mentioned, on the authority of Mr. Graff, that the first cast-iron mains laid in Philadelphia were cast in June, 1820, by Mr. Samuel Richards, of that city. These pipes were made upon specifications drawn up by Mr. Frederic Graff, Sr., on Jan. 26, 1819; and the pipes were in constant use for 53 years. They were made of charcoal iron and cost 5 cts. per lb. The specifications provided for pipes from 3 ins. to 20 ins. inside diameter; the 12-in. pipe, 9 ft. long, weighed 700 lbs.


RESERVOIRS
CONTAINING TOGETHER
17000 GALLONS
TUNNEL SUPPLIED BY THE ENGINE AT THE SCHUYLKILL
Drawn by Frederic Graff from the original drawings and memoranda in his possession
Scale of Feet.

SECTION THROUGH ENGINE HOUSE OF THE CENTER SQUARE WATER-WORKS, PHILADELPHIA.
(Reproduced from a drawing made by the late Frederic Graff from the original drawing of the engine.)

The engines used at the Schuylkill and Center Square pumping stations were built by Mr. Nicholas J. Roosevelt, at his Soho works, about four miles from Newark, N. J. The cylinder for the Schuylkill engine was 6 ft. 6 ins. long, was 38¼ ins. inside diameter and weighed 7,500 lbs. when cast. It was cast in two pieces united by a copper joint, and secured externally by a cast-iron band 18 ins. wide and weighing 1,200 lbs. The boring of this cylinder was done by power furnished by a 30-ft. water wheel; the three steel cutters, each 3½ ins. wide, were fitted to a headpiece attached directly to the iron shaft of the water wheel. The work was slow, and 4½ months were consumed in boring this cylinder. The engine for which this cylinder was made drove a double-acting pump, 17½ ins. diameter and 6 ft. stroke. The Center Square engine, built at the same time and place, had a 32-in. cylinder with 6-ft. stroke, driving a double-acting pump 18 ins. diameter and 6-ft. stroke. The Schuylkill engine lifted the water 39 ft., and that at Center Square, 51 ft. In both of these engines the lever arms, flywheel shaft and arms, the flywheel bearings, cold-water cistern and even the external shell of the boilers, were all made of wood.

The boilers deserve especial mention. They were rectangular chests, made of 5-in. white pine planks, assembled and braced together as shown in the illustration. Inside this chest was a cast-iron firebox, 12 ft. 6 ins. long, 6 ft. wide by 1 ft. 10 ins. high, with six 15-in. and two 12-in. vertical flues. The water circulated through these flues and the fire passed around them and through an oval flue that was carried from the back end of the firebox nearly to the front of the boiler and then back again to the chimney. A later firebox was made of wrought iron with cast-iron flues; but on account of unequal expansion and contraction this was finally made entirely of wrought iron.



Stop-Valve Used with Wooden Water Pipes in Philadelphia; 1801 to 1844.

These wooden boilers leaked so badly that on Dec. 1, 1801, a boiler with a cast-iron shell was substituted at Centre Square; and in March, 1803, another of different design was substituted for the wooden boiler at the Schuylkill works. These two boilers are here shown, and they were used until 1815; Mr. Latrobe said, however, that the Schuylkill boiler especially, required "a very active fireman."

From the records preserved of the two engines, it seems that the duty of the Schuylkill engine was 4,790,000 lbs. of water raised 1 ft. high per 100 lbs. of coal consumed; that of the Centre Square engine was 4,091,000 ft.-lbs. The Schuylkill engine lifted 1,474,500 gallons of water 39 ft. high in 24 hours, with a consumption of 70 bushels of Virginia coal. The Centre Square engine lifted 962,250 "ale gallons" 51 ft. high in 24 hours with an expenditure of 55 bushels of the same coal. The engines cost the corporation $31,818.32, exclusive of $942.81 paid for the supporting frames. Mr. Latrobe was paid $6,350 for his services as engineer; and the Water Committee rejected his claim for an additional compensation of $1,925. The report of this Water Committee of 1801 also incidentally notes that liquor had been furnished to the workmen to the amount of $898.44.

A SMALL "HOME-MADE" DIPPER DREDGE OR STEAM SHOVEL.

There are many places where it is very difficult and expensive to take a dredge or steam shovel of moderate size, and there are many other places where the amount of excavation to be done is so small as to ordinarily make it unprofitable to attempt to use machinery. A simple and effective power excavator adopted for use either as a dredge or a land shovel was operated for some

time by a member of our editorial staff, and the details of the parts are illustrated herewith.

While, as shown in Fig. 1, the excavating machinery may be mounted upon scows so as to form a dredge, it may also be mounted on trucks and used as a steam shovel of no mean efficiency considering the force of men employed.

Two scows, each of the dimensions shown in Fig. 2, are fastened together side by side as shown in Fig. 3. It is preferable to build two scows instead of one, for each can then be loaded upon a wagon, and one can be placed on top of the other on an ordinary flat car for railway transportation. These particular scows were made of rough 2-in. pine plank nailed to four roughly-made trusses as shown in Fig. 2, and calked. At first such scows leak somewhat, but a small hand pump will readily keep them bailed. Two spuds, shown in Figs. 1 and 8, support the front end of the scows during digging, the upper end of each spud being provided with teeth that fit into the rack on the A-frame shown in Fig. 3. The spuds are raised by a rope that runs back to the winch head of the engine. A single spud in the stern (Fig. 1) is handled in a similar manner by the engine. This engine is an ordinary single drum (friction clutch) double-cylinder hoisting engine of 8 HP., this particular engine and boiler being made by The American Hoist & Derrick Co., of St. Paul. The cylinders are 4¾ × 6 ins. The engine and boiler has a shipping weight of 3,500 lbs. The next size larger, 10 HP., would in many cases be worth its added cost.

A wooden framework was built, as shown in Fig. 9, and four additional drums and gear wheels were mounted on it by a local machinist. The two smallest of these drums (3 ins. diam. × 8 ins. long) swing the dipper crane by means of chains. To effect a right or left swing as desired, each of these 3-in. drums has a conical friction clutch operated by a lever under the control of the dipperman at the front of the scow. The rest of the engine mechanism is under the control of one man—the engineman. Fig. 10 shows the levers under his control; L is the lever operating the friction clutch of the main or hoisting drum which is held in the right hand; V is the lever with which the steam supply is controlled by the left hand; P is the lever that operates the clutch controlling the middle drum, around which is wound the pull back chain (Fig. 1) from the dipper (Fig. 2 shows two of these drums, marked "Drum," but only one was actually used), and this lever P is operated by the left shoulder of the engineman; F is a foot lever controlling the brake rope (Fig. 1) that restrains the dipper from sliding down while it is being pulled back to take a new scoop.

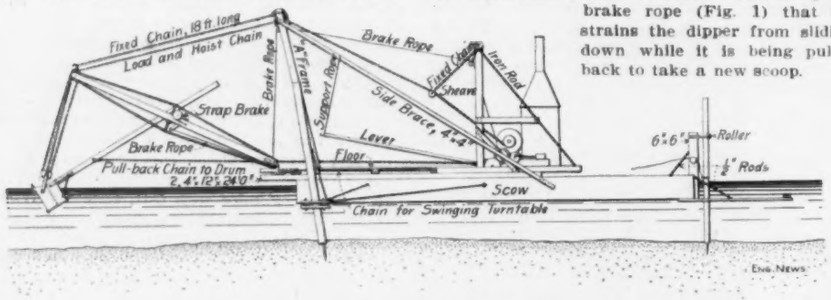


FIG. 1. ELEVATION OF DREDGE.

It will be seen that the engineman is called upon to do a good many things, and that his job is no "snap," but it has been found possible for a man to learn in a short time to thus handle the dipper with rapidity and with perfect success.

The details of the dipper itself and its arm or handle are well shown in Fig. 6, where it will be seen that its capacity level full is 9 cu. ft., or ⅓ cu. yd. This dipper was made also at a local machine shop. Fig. 7 shows the boom, consisting of two yellow pine (3 × 8 ins.) sticks trussed with ¾-in. rods above and below and on both sides. The dipper arm or handle, as shown in Fig. 1, passes between these two pine sticks of the boom, and the cog racks on the lower side of the dipper handle travel on 3-in. pinions mounted, as shown in Fig. 7, on the boom. These pinions are keyed to a shaft on the outer end of which is keyed a wheel controlled by a brake strap, so that the dipper arm can be held at any desired position. The lower end of this boom is fastened to the turntable shown in Fig. 5. The turntable is pivoted on the frame shown in Fig. 4, and the two 4 × 12-in. × 24-ft. sticks, there shown, run back under the engine bed so that the weight of the engine and boiler counterbalances the weight of the dipper, boom, etc.

To show how cheaply the scows can be made, calked with oakum and pitched, we may add that

COST OF THE DREDGE.

1 Hoisting engine and boiler	$300
2 Scows, 3,200 ft. B. M.	100
10 Sheaves, 6-in.	20
120 ft., 7-16-in. hoisting chain, 250 lbs. at 8 cts.	20
160 ft., ¾-in. iron, 250 lbs. at 4 cts.	10
1 Dipper, 400 lbs. at 10 cts.	40
1 Turntable plate and rim, 100 lbs. at 10 cts.	20
100 Bolts, ¾ × 12 ins., 200 lbs. at 5 cts.	10
1,000 ft. B. M. yellow pine	10
Labor and sundries not included above	200
Total	$1,000

a carpenter and a laborer were just 6 days in making two scows; 15 lbs. of oakum were used in calking. The following spring both scows were re-calked (8 lbs. of oakum) by two men in 7 hours, then two men and a team were engaged 15 hours in skidding and launching the scows.

COST OF DREDGING.

This dredge, including its scows, can be loaded on two flat cars (one would hold it) and it makes only four ordinary wagon loads over good earth roads. It takes 4 men 2½ hours to load each scow onto a wagon and ½-hour to unload. The crew is 3 men, consisting of an engineman, a dipperman and a fireman. After the scows are launched, this crew will place the engine and boiler on the scows in half a day, and will rig the dredge in two days more.

Records were kept of the work done by this bantam dredge under a variety of conditions. It will dig a channel 18 ft. wide and 12 ft. deep with the dipper arm of the length shown, but for deeper digging a longer arm will be needed. By actual count 63 dipper loads were excavated in 48 mins., including 8 mins. for two forward moves of 5 ft. each, at which rate 25 cu. yds. of river gravel were excavated per hour. The average output for a 10-hour day was 175 cu. yds. in river gravel where occasionally a boulder would be dug up that completely filled the bucket. In hardpan this dredge averaged only 60 cu. yds. a day, alongside of a 1 cu. yd. dredge that did but little better, showing that, small as it is, the dredge will handle the toughest of material.

In pretty difficult material the dredge can be counted on for 150 cu. yds. per day of 10 hours, with a crew of three men, and a coal consumption of ¼-ton. Thus, at an expense of about $8 a day for labor and fuel, river gravel can be dredged for 5 or 6 cts. per cu. yd. with a small and simple machine whose first cost need not exceed $1,000.

Moreover, in the interim of dredging work, if there is any pile-driving or other hoisting engine work to do, the dredge can quickly be dismantled and its engine used for that purpose. Mounted on rollers or on wheels it has been used advantageously in dry excavation.

We may suggest in closing that in a new country, like Alaska, where labor is scarce and high-priced, an outfit of the kind described could be used in placer mining work on many a small claim that would not warrant a more expensive plant.

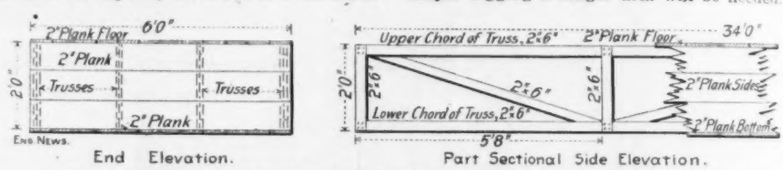


FIG. 2. END ELEVATION AND PART SECTIONAL SIDE ELEVATION OF SCOW.

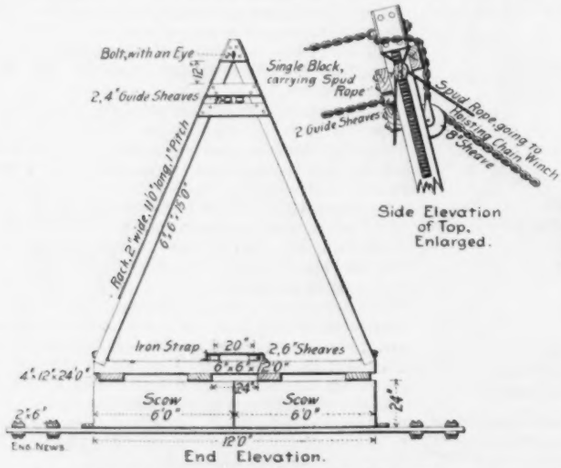


FIG. 3. END ELEVATION OF A-FRAME AND DETAIL OF TOP.

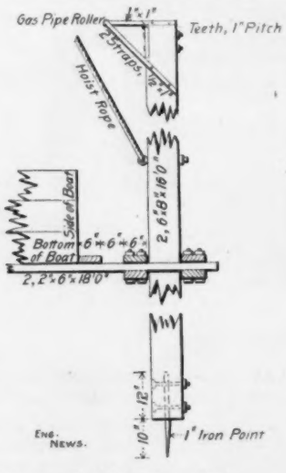


Fig. 8. End Elevation of One A-Frame Spud.

THE DESIGN AND EQUIPMENT OF RAILWAY REPAIR SHOPS.*

By George A. Damon.†

The art of designing, equipping and operating railway repair shops has not yet been reduced to an exact science, and at the present time it is very improbable that any two interested parties will agree upon either the requirements or the details of the solution of any given general shop problem. The ideal shop, of course, will never be built, but it is possible that out of the chaotic condition now existing there will be evolved tendencies in certain directions.

Unfortunately most shop descriptions have been written with a favorable pen, and very little of a critical nature

*Abstract of paper read at the meeting of the Western Railway Club, Chicago, on April 21, 1903.

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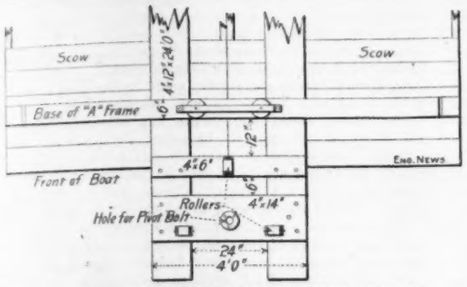

FIG. 4. PLAN OF FRAME SUPPORTING TURN-TABLE.

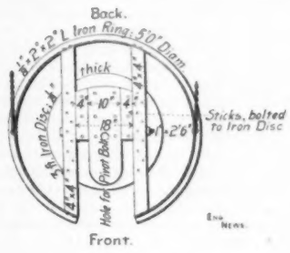

Fig. 5. Plan of Turntable.

has appeared in print. It is with the idea that more unfavorable comment will be passed upon a proposed plant than upon one which has already been built that has encouraged the writer to present the following description of a complete repair shop which as yet exists only on paper. A large part of the matter was contained in a report which was intended to be only of a preliminary nature. The example may, therefore, be considered as both hypothetical and actual, and should serve the purpose of focusing the discussion upon a shop of this particular size, leaving the larger problems for future consideration.

GENERAL PLAN OF NEW SHOPS.

The existing shop facilities have proved entirely inadequate for existing requirements. Since the shops were built, the rolling stock of the railway has been increasing in quantity, and the additions are both larger and heavier than the earlier equipment. It is proposed to better conditions by either altering and extending the present plant, or by building new shops complete, and it will be well to discuss here the question of entirely new shops.

After several studies of possible arrangements the one shown in Fig. 1 was selected, and is advocated as possessing the following advantages:

1. One transfer table with its crew serves the machine, boiler, paint and coach shops, as well as the repair tracks and the coach and engine storage space.
2. Provision is made for 100% extension in every department.
3. The storehouse is central, and at end of transfer table, as well as convenient to two tracks, and near main track.
4. The oil house is isolated, but near main track, and near roundhouse.
5. The machine shop, boiler shop, blacksmith shop and roundhouse are within convenient reach of one another.
6. The blacksmith shop is near repair tracks and convenient to scrap bins.
7. The power house is central and near planing mill, at the end of repair tracks; it is convenient to coal track serving roundhouse, and also to coal-storage space.
8. The planing mill is near center of repair tracks and between lumber storage space, but with lumber yard furthest removed from shop buildings.
9. The roundhouse is near main tracks and provided with two approaches which do not interfere with movement of engines or cars to be repaired.
10. Buildings are separated from one another at least 50 ft. for fire protection.
11. All departments are within 1,000 ft. of the central power plant.

It should be noted that the annual snowfall in the locality is very light, so that the usual objection to a transfer table does not apply in this case. The temperature is generally mild and seldom drops to zero, so that the use of side doors opening upon the transfer table, serving the transverse pits of the main shops, is not objectionable here as it is said to be in colder climates.

DESIGN OF BUILDINGS.

BOILER SHOP AND ERECTING SHOP.—There are now being operated upon the railway in question 116 locomotives, the largest of which weigh 100 tons, and are 53 ft. 6 ins. long over the tender. As the service is severe, each engine should pass through the shop at least once a year. With a modern shop the average length of time for overhauling should not be over four weeks. Allowing 13 engines per pit per year it will require nine pits for regular repairs. Provision for growth and accidents will make 11 stalls for the erecting shop advisable, and space equivalent to five stalls should be allowed for the boiler and tank shop.

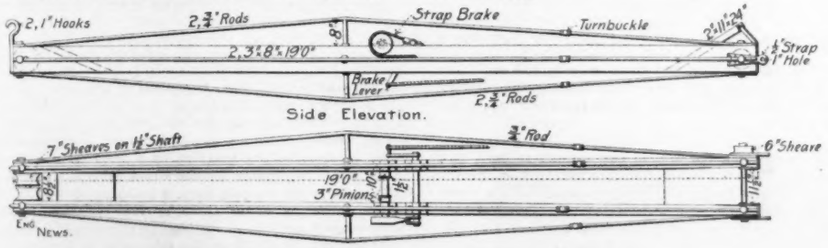

FIG. 7. SIDE ELEVATION AND PLAN OF BOOM.

The erecting and boiler shops are contiguous, as shown in Fig. 2, it being the intention to place the annealing furnace on the outside of the building and make provision to thoroughly remove the smoke from the other fires in the boiler shop. Both will have the same cross-section and be of similar construction, making a building 140 × 300 ft. The advantage of this arrangement in a shop plant of this size is that one set of cranes can be used for both departments, the stalls can be employed for either boiler or engine work as occasion may require, and extension of either department can be easily accomplished. The fact that the boiler of an engine can be carried from one shop to the other and that the tools of one department are available in both, are important considerations in favor of a combination shop. A 16-ft. curtain wall could be put in place between the two departments.

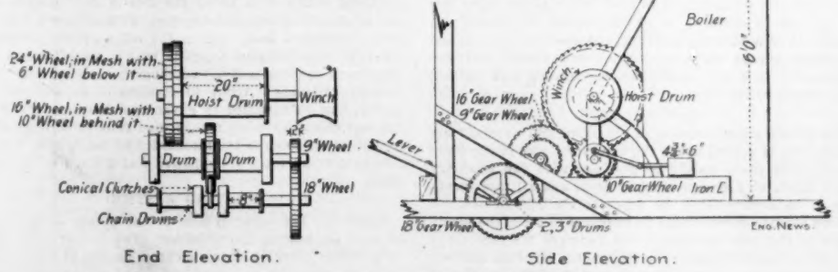

FIG. 9. ELEVATIONS OF ENGINE.

This building consists of steel frame work construction supporting the roof trusses entirely independent of outside brick walls, as shown. All buildings will have composition roofs, nearly flat, with a pitch of not more than 1 in. per ft. The shop is divided into three aisles by columns supporting the crane runways and gallery girders. The largest bay is spanned by a crane for lifting locomotives, while a crane of much smaller capacity is arranged to serve the space provided for individually motor-driven tools. This small messenger crane is also intended to deliver material upon the landing platforms of the gallery, which has been provided for light belt-driven tools, for the brass and tin shops, the headlight, air-brake repair and instruction departments, etc. The space under the gallery is available for the grouping of the smaller belt-driven tools, and also for the tool rooms, which will be placed centrally so as to be used by the boiler, the machine and also the blacksmith shop departments.

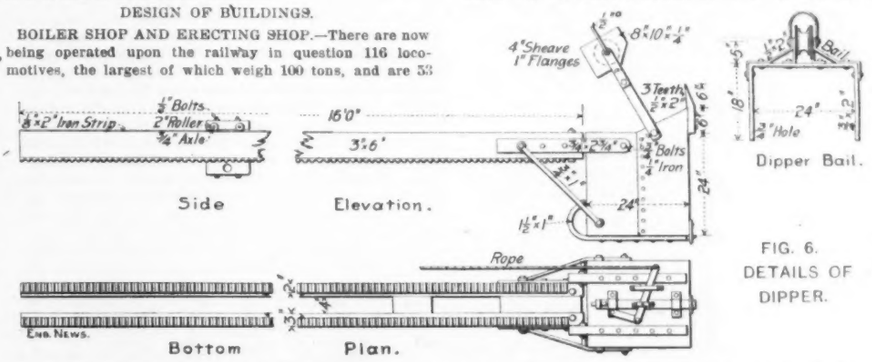

FIG. 6. DETAILS OF DIPPER.

The transverse pits for the engines will be 22 ft. c. to c., but will be off center of trusses as far as possible to allow for the introduction of a window at the side of each outside door. These doors are of the lifting type and also provided with a moderate amount of glass surface. Pass doors will be provided on the transfer table side by using part of the side windows in every other bent. Every advantage of modern construction methods will be taken to secure all the light possible without exposing the workmen to the hot-house effects of the sun bearing directly through overhead skylights. The saw-tooth principle will be used for some of the overhead lighting, and the use of translucent fabric should also be considered. Racks will be located between pits for the purpose of storing pipes, rods, etc., and these racks will be broad enough on top for the purpose of supporting and storing the cab.

The floor of the machine and boiler shops will be of 3-in. planks, spiked without splines to heavy nailing strips imbedded in concrete carried on a foundation of cinders. The side walls of the pits will be of concrete, but the bottoms will be arched with vitrified brick and each pit will be drained at the middle instead of at the end.

A lye vat will be built near one end of the locomotive shop for the cleaning of engine parts, and a flue rattler operating in water under the floor will be placed convenient to the boiler end of the shop, and both of these conveniences will be served by the large crane by means of special baskets.

Provision will be made for a riveting tower in the boiler shop to be built at some future time when the making of boilers in sufficient numbers will justify the extra expense. This tower will eventually be equipped with a 30-ton crane, which will be located so that a boiler can be delivered to it directly by the large crane from the machine shop.

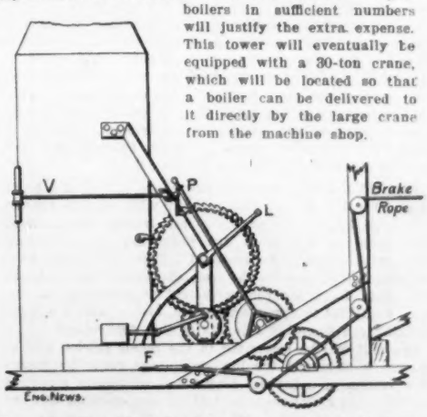

Fig. 10. Elevation Showing Levers Controlled By Engineman.

BLACKSMITH SHOP.—This will be 100 × 150 ft., placed at right angles to the boiler shop, but separated from it by a fire wall and fireproof automatic sliding doors. This shop is built with brick pilasters supporting iron roof trusses containing a large monitor for light and ventilation. In addition, the side walls have lifting and folding doors in each bent, so that in mild weather the smiths can practically be working in the open air. The forges are to be arranged in the middle of the shop with the tool racks between, and the scrap and other furnaces are to be placed on the outside of the building. Center posts will be used to lighten the roof trusses, and some system of smoke removal which will be an improvement over the present popular down-draft arrangement, should be adopted. A track through the shop leads to both the main shop cranes and extends outward to the rip tracks and scrap bins. Iron and coal storage space should be convenient. Jib cranes will serve the large fires and the steam hammers, and the floor will be of cinders.

COACH SHOP.—This is to be 100 × 180 ft. Allowance for caboose, refrigerator, and similar work, would make a seven or eight-stall shop desirable. This building will be provided with space for varnishing, upholstering and cabinet work. The monitor in the roof can run lengthwise of the building. The tracks will be 22 ft. c. to c.

Offices will be provided in each department by means of glass enclosed compartments of standard design. The general offices will be preferably in connection with the storehouse, but upon the second floor, and will have vaults for the records and toilet rooms for the office employees.

OIL HOUSE.—This is to be built with two floors, the upper one on a level with the storehouse platform, and the basement floor fitted with a well-ventilated space for large oil tanks for the various kinds of oil; each tank having a capacity about 20% greater than that of a tank car. A separate fireproof room for oily waste will be provided. All electric wires are to be in iron conduits and all electric lamps enclosed in vapor-proof globes. The building is to be built of brick and iron, and the surrounding platform of concrete, to reduce the fire risk to a minimum.

PAINT SHOP.—This serves at the present a total of 76 passenger coaches, which, if passed through the shop once each year, each one staying for a period of three weeks, will require five stalls. If provision is made for the growth of the coach equipment and also for painting tenders, cabooses, etc., the paint shop should have seven to eight stalls, the same as the coach shop, to which it will be adjacent, and 100 × 180 ft. in size. As provision should be made for permanent adjustable scaffolding, the same supports can also carry part of the roof load, and thus lighten the trusses. Transverse monitors should supply the light from above.

A separate fireproof building will be built for the storage and mixing of paint, and all brushes and paint pots are to be returned to this separate building when not in use. In some paint departments a separate system of pipes is installed for the distribution of naphtha gas which is generated outside of the building, and is used for burning the paint off the cars. Ordinarily the scraping of coaches should be done in the coach shop in order to avoid dust in the painting and varnishing department. The paint shop floor will be of concrete, cement finished, and care will be given to the question of drainage.

PLANING MILL.—For the new shops this should be at least 80 × 150 ft. It will be built with wooden trusses supported by wooden posts, as iron trusses would afford practically no additional fire protection in a building filled with inflammable material. This shop is to have additional lighting from the roof, and should have numerous large doors for the movement of material. A dry kiln, a finished lumber storage shed, and a pattern storage building are desirable adjuncts to this department.

The mill will be connected to the repair tracks, and to the coach shop and the lumber storage yards by means of a system of industrial tracks and turntables arranged for the most direct movement of its raw material and the finished product. The mill floor should be of wood.

POWER HOUSE.—This is to be a practically fireproof building with a dividing fire wall separating the engine and boiler rooms. The floors and all foundations for machinery, etc., are to be of concrete. The engine room floor may be above grade to provide a high basement for the piping and steam auxiliaries. The central location of the power plant will allow it to contain not only the heating, lighting, power, compressed air and water equipment, but also pumps for oil to the boiler and blacksmith shop, and hot-water pumps for the roundhouse and main shops. Ample provision should be made in the building to take care of at least 50% additional equipment without adding to the building proper. A brick chimney 7 ft. diameter and 150 ft. high is to be built, and will be connected to the boilers by means of an underground brick flue.

ROUNDHOUSE.—This will have at least 30 stalls and should be constructed with brick side and brick walls, but with a wooden roof supported by wooden posts. The ultimate capacity should be for at least 50 engines. The depth of the house will be at least 90 ft. The lighting is to be provided by sash in the front swinging wooden doors, by a broken roof, and by extra large windows in the back wall between pilasters. Some provision is to be made by means of cheap construction to repair the back wall when accidentally injured by a pilot.

Wooden smoke jacks are to be preferred and these will be painted and sanded for fire protection. Ventilators should be provided in addition. The engine pits may be of the construction as used for the erecting shop pits. A mechanical exhaust system is the latest development. The foreman's office should be central and near the enginemen's rooms. These latter should be provided with lockers, wash and toilet-room appliances, and shower-bath facilities. A tool storage room is also desirable. The roundhouse floor will be of vitrified brick laid for effective drainage. Drop pits of concrete are to be provided for removal of both driving and truck wheels, and both pits should be equipped with pneumatic hoists. The driving wheel drop pit may be placed on the track leading to the transfer table.

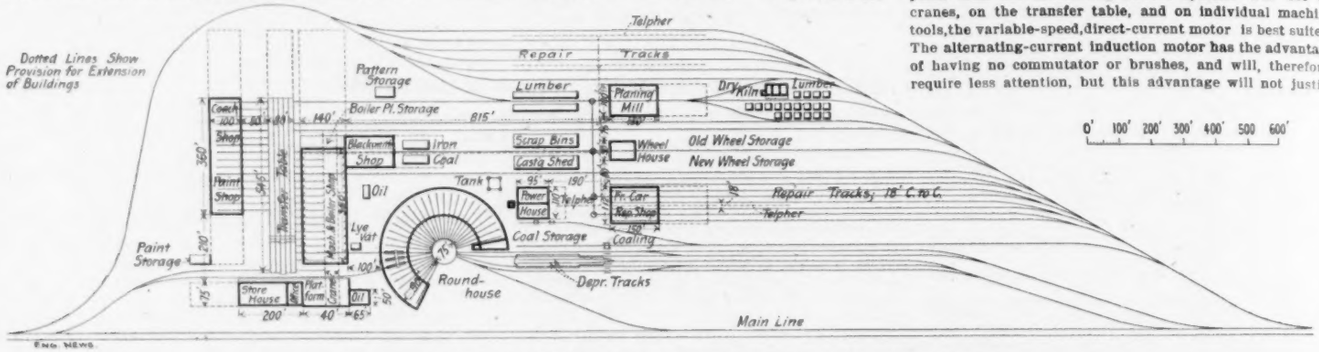

FIG. 1. PLAN OF RAILWAY REPAIR SHOPS FOR SERVING 116 LOCOMOTIVES.

MISCELLANEOUS FACILITIES.—Cinder pits, long enough for cleaning the fires of two engines at once, will be placed on two incoming tracks with short extensions under the two outgoing tracks. Abundant storage track for incoming engines will be provided. A coaling station with coal pockets on each side will be provided, and enough engines are coaled at this point to justify the installation of a plant with bucket conveyors and ash-handling apparatus. The sand storage is to be placed next to the coal pockets, and this will be provided with steam coils for drying the sand, and a reservoir with air connections to elevate it so that it can be delivered to the engines by gravity.

A storehouse is shown at the end of the transfer table as an extension to the two-story office building. This is to be a one-story structure with plenty of long windows and doors opening out on a platform surrounding three sides of the building. This platform is to have two inclines reaching to the grade level, one of the inclines being arranged to deliver goods directly at the main shop door and convenient to either crane.

Scrap bins will be built upon a platform 4 ft. above the track and are to be located central with the repair tracks and within easy access of the blacksmith shop. Each bin will have a capacity of at least one car, and there will be at least 30 of them. A wheel shop for car wheels can be placed in a separate building, and should be convenient to ample storage space for old and new wheels, and also convenient to a depressed track for loading and unloading wheels by hand.

CRANES, ETC.

An 80-ton crane, capable of standing 25% overload occasionally, is needed above the transverse pits in the main shop. This crane should be provided with two auxiliary rapid hoists of five tons capacity each, and all movements are to be accomplished by separate electric motors. A 10-ton electric crane should be provided to serve the heavy tools in the machine shop. The runways for this crane can be extended through the side of the building and out over two tracks, and also over a portion of the storehouse platform. This will allow for the transfer of material by crane from one car to another—or from a car upon either track to the storehouse platform—or directly into the main shop. A 10-ton hand crane should be installed over the equipment in the power plant engine room.

An electric messenger telpher could be installed to advantage between the scrap bins, casting shed, repair tracks, wheel house, roundhouse and blacksmith shop. Air hoists, or the recently developed electric hoist, may be provided over all heavy tools not served by an electric crane. Jib cranes are to be used in the blacksmith shop.

The turntable pit will be of concrete, with a heavy oak curbing carried on the wall, to which will be bolted the frogs around the rim. The turntable itself is to be of 200 tons capacity, and of the deck pattern, carried on a central pivot supported by a heavy isolated concrete foundation. An electric motor operated from a cab set over the motor carriage will turn the table completely in 30 seconds in an economical manner.

The transfer table pit will be made as shallow as possible in order to present the minimum obstruction to traffic between the shops on opposite sides of the pit. The track runways will be of concrete with broad footings. The outside wall should be extra heavy to withstand the shocks of engines moving on and off the table. The transfer table is intended to serve both the engine and coach departments, and, therefore, will be of 120 tons capacity and 75 ft. long. It is to be fitted with a motor capacity of 40 HP., and will be equipped with a winding attachment with a cable which will reach anything within 250 ft. of the sides.

ELECTRIC SYSTEMS.

In the present state of the art the 250-volt direct-current system is better adapted for all around railway shop purposes than the alternating-current system. For use on cranes, on the transfer table, and on individual machine tools, the variable-speed, direct-current motor is best suited. The alternating-current induction motor has the advantage of having no commutator or brushes, and will, therefore, require less attention, but this advantage will not justify the extra first cost involved in its installation under existing commercial conditions, in a plant of this size.

As a general rule all machines requiring over three or four horse-power should be equipped with a separate motor. Smaller machines can be arranged in groups each driven by line shafting operated by a motor of a uniform 10-HP size. To provide for the speed control of about a dozen tools in the erecting shop, a balancer set will be installed delivering either three or four voltages to the variable-speed motors.

The lighting should be on the three-wire system, with a compensator at the power plant and all incandescent lamps for local illumination and the enclosed arc lamps for general illumination about the shops and grounds should be operated at 110 volts. Plug outlets of a specially heavy design will be distributed liberally, and the use of torches in the buildings should be entirely discontinued. The wiring may be carried from the switchboard to the buildings in tunnels or conduits. All branch wiring for power about the shops will be protected by iron-pipe conduit, which can also be used liberally to protect the lighting wires. Considerable care will be taken in planning the wiring system to provide for extensions and additions, and to avoid the cobweb appearance presented by some of the recently-built shops.

The cranes and transfer table will be on a separate circuit provided with an ammeter on the switchboard to indicate at once the location of excessive loads. The transfer-table wiring is to be on the side of the runways and not overhead. A telephone system, with an instrument on every foreman's desk, and in the office of every department, will be installed complete with a central board. A fire-alarm system and a watchman's-clock system will also be desirable. About 40 stations of an annunciator system can be installed to advantage in connection with the tool room in the main shop, and thus make it possible to deliver the tools to the mechanics by messenger. Under this system all tools are repaired and ground in the tool room.

HEATING SYSTEM.

Either the hot-water system or the blower system may be used for heating the buildings. The former is thought to have the following advantages: A, control at one central point by means of changing the speed of the centrifugal

pump in the power plant; B, absence of back pressure on the generating-plant engines; C, absence of drafts on the workmen as complained of with the blower system; D, small amount of space occupied in the shop buildings; E, minimum attention required for operation. If the blower system is installed, the fans should be located on the floor, and the air should be discharged along the outside walls, preferably from underground ducts.

For the roundhouse heating there is no better system than the fan or blower system. In this building the heat from the heating coils should be distributed by means of underground ducts to the engine pits. The fan and engine should be placed in a small addition to the roundhouse located on the power-plant side.

There will be required to heat the buildings to a temperature of 60° F., with an outside temperature of —10°, a total of 750 HP., but the average boiler capacity during cold weather will be less than 500 HP.

POWER PLANT.

The boilers will be of the water-tube type, three in number, of 250 HP. each. The generators will be of the direct-current, 250-volt, compound-wound type, directly connected to compound engines running at moderate speeds. One unit should be of 200-KW. capacity, and the other of 100-KW. capacity. The engines will be operated non-condensing, as a condenser and cooling tower equipment will not save enough fuel to pay interest on the extra investment.

The compressed-air system will be served by a compressor having a capacity of 1,000 cu. ft. of free air compressed per minute to 100 lbs. pressure. The fire pump

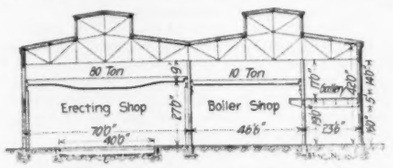

Fig. 2. Cross-Section of Locomotive Erecting and Boiler Shops.

will have a capacity of four fire streams throwing a total of 1,000 gallons of water per minute.

Mechanical stokers may be adopted at some future date when a continuous supply of slack coal for the power plant is assured, but at the present time it will suffice to so brick in the boilers that the stokers can be added when wanted. An elaborate system of coal and ash-handling equipment will not be justified in a plant of this size, as the average consumption of fuel will not be over one ton per hour. The coal can be delivered to the boilers, however, by means of a firing car, getting its supply from the bottom of a bin by gravity, and the ashes can be handled by push cars running underneath the grates, and delivering to an ash hoist at one end of the plant.

The power plant should be the location of the hot-water pump for supplying the roundhouse and main shop with cleaning-out water under pressure, and a hot well should be provided between the roundhouse, the main shop and the power house, to save the heat of the steam and water blown off from the engines, and also from power-house boilers.

A switchboard will control all the lighting and power feeders through circuit breakers. Recording wattmeters will be provided to record the amount of electric energy used during given periods. The power plant will have all the usual accessories, such as heaters, oiling system, feed pumps, injectors, drip system, etc.

PIPING OUTSIDE POWER HOUSE.

The air system will distribute the compressed air to outlets at every pit in the erecting and boiler shop; at every column in the machine shop; for use in the coach and in the paint shops; at every pit in the roundhouse throughout the repair tracks; in the blacksmith shop; for raising oil in the oil house and from the fuel-oil tanks; for raising sand in the sand house, etc. Large air reservoirs, 6 × 20 ft., will be liberally used. An after cooler can be made from an old engine boiler.

The live-steam system will distribute high-pressure steam to the pits in the engine shop and roundhouse; to the steam hammers in the blacksmith shop; to the fan engine in the roundhouse, and to the transmitter tanks in the toilet rooms.

The hot-water system will take the water from the hot well, where it has been heated by the steam escaping from the houndhouse engines, as well as from the blacksmith shop steam hammers in the summer time, and pump it through an auxiliary heater to the engine pits ready for cleaning out or filling up the engines with hot water.

The heating system will have an entirely independent set of mains and returns, so arranged, preferably, that the heat to any one building can be controlled separately. All water condensed in the heating system should be returned to the boilers.

The oil system is to supply fuel oil to the furnaces in the blacksmith and boiler shops, and deliver oil from the tanks in the oil-house basement to the distributing floor above through reservoirs, each of which has a capacity 20% greater than a barrel.

Tunnels or subways, about 6 ft. deep by 5 ft. wide, will be provided for the pipes between the power plant and the main buildings. As this distance is very short, this expense will be justified in order to clear the yard of unsightly obstructions. This subway can be made of concrete or brick side walls with removable top of concrete slabs, which can be used as a sidewalk.

The sewer system should start at the toilet rooms, where flushing tanks of ample capacity will be provided, and will connect with the city system through pipes of liberal size. A blow-off system entirely separate from the other system should be considered. It might be well to so connect the down spouts from the central buildings into one outlet so that a pump or cistern could be installed at some future time to store the roof drainage. The grade of the sewer will be low enough to drain the turntable, transfer table, and engine pits, as well as the power plant basement. The plumbing in the toilet and locker rooms will be open and modern. The washing sinks of enameled iron are to be provided with hot and cold water. A good location for one of the toilet rooms is in the gallery above the machine shop.

WATER SYSTEM.

The primary source of water supply will be an 8-in. connection from the city main. This 8-in. supply will be brought directly into the power house through a meter and check valve, where, by means of gate valves under the control of the engineer, it can be fed to the water tower or tank direct; to the shop system direct, or to the fire pump direct, or to all at once; back water or check valves being used for connections to lines carrying fire pressure, with checks opening against the high pressure.

The water tower or tank is used as a surge tank or reservoir to serve as an equalizer between the regular supply and the variable demand. In case the city water should give out during a fire the tank would continue to feed the fire pump. A second auxiliary supply may be had by gathering up the rain water leaders from all the buildings and carrying them to a cistern near the power house, and cross connecting the suction of the fire pump into same. This water can be used for boiler-feed purposes as well as serving for fire supply reservoir.

From the power house, the shop and fire mains will be carried in two directions, controlled by valves. These mains will be cross-connected into loops so as to lessen the liability of any fire hydrant or building being left without water in case of accident to any part of the mains. Valves will be so placed on the mains and cross-connections as to control the different parts of the system. There will be 16 fire hydrants, placed with reference to best fire protection, so that from any point within the limits of the shops or mill yards there will be not less than two hydrants within 300 ft. The hydrants are placed at safe distances from all buildings and where they will be easy of access.

Inside the buildings there will be hose hydrants every 200 ft. of building length, with swinging hose reel and 150 ft. of hose. The shop-supply outlets will be taken from the same mains as the fire lines, and will in general be so distributed in each building as to bring a water cock on every other post or every other bent. All water piping inside the shops to be wrought iron, screwed fittings; all water mains outside of buildings to be cast iron with solder-calked joints.

TOOLS AND MACHINERY.

In order to utilize the shop space to the best advantage, and decrease the time of engines in the shop, all tools should be selected with a view to their particular adaptation to the work to be done. They must be designed to use the new high-speed tool steels to greatest advantage, and so arranged with relation to cranes and one another that a minimum handling of material will be necessary. Their number and capacity should be such that all machine work will move forward uniformly, resulting in all parts for each engine being completed and ready for erection when needed.

Great care should be given the proper grouping of the tools into departments. For example: the rod, link and crosshead work should be done at one point, near which should be the piston and valve work. So also, the stud lathes, brass lathes, etc., should be grouped together and convenient to the tool stock room where their products are kept.

This plan should be followed in the boiler shop, blacksmith shop and planing mill. In the latter the proper allotment of space to each machine is important, and also their arrangement with a view to having the various operations follow the natural movement of the lumber, so that no extra handling need be done.

THE LJUNGSTROM CONDENSER AS APPLIED TO MARINE ENGINES.*

By William Cross, Assoc. Inst. Naval Archs.

The ordinary surface condenser is so well known and universally used that it would seem almost presumptuous to contend that any radical improvement could be made in its design. The author may therefore be pardoned if he gives the reasons which first led him to consider that some improvements were possible.

Mr. Seaton, in his well-known book on "Marine Engineering," states that for modern mercantile triple engines the ordinary cooling surface allowed is 1.3 sq. ft. per I. HP., for His Majesty's naval engines 1.1 sq. ft., and for torpedo-boat destroyers 0.75 sq. ft. per I. HP.; and this may be taken as fairly representing ordinary practice. The ordinary outside condenser, as largely used for small powers, consists usually of one or more D-shaped copper pipes fixed on the outside of the hull near to the keel, the steam being delivered into the forward end, and the air pump suction taking from the after end. A very large number of such condensers have been fitted by Messrs. Simpson, Strickland & Co., Ltd., and examination of their standard drawings showed that the average proportion was 1 sq. ft. for 2 I. HP., being thus less than one-half what Mr. Seaton allows, and yet, when tested under identical conditions, the outside condenser showed itself fully as good, if not somewhat better, than the inside. From this it appeared that there was a possibility of very considerable improvement in the design of the inside condenser as usually made. The author's practice is largely in connection with small vessels of comparatively very high speeds, and the weights and size of the condenser necessary is always one of the most difficult matters to deal with in the design, and this difficulty would be apparent in all cases where the maximum horse-power has to be got into an exceedingly limited space and weight, as for example, in torpedo-boat destroyers or cross-channel steamers. In the case of mercantile steamers it is obvious that any saving in engine-room weights could be devoted to profitable cargo.

The Ljungström condenser is the invention of a Swedish engineer, Mr. F. Ljungström. It consists, briefly, of a number of thin diagonally corrugated chambers or elements of brass fixed together in packets, so arranged that the corrugations mutually support one another. These packets are fixed in a rectangular casing in such a manner that the cooling water flows horizontally through the chambers, and the steam flows vertically outside the chambers, it being understood that the space through

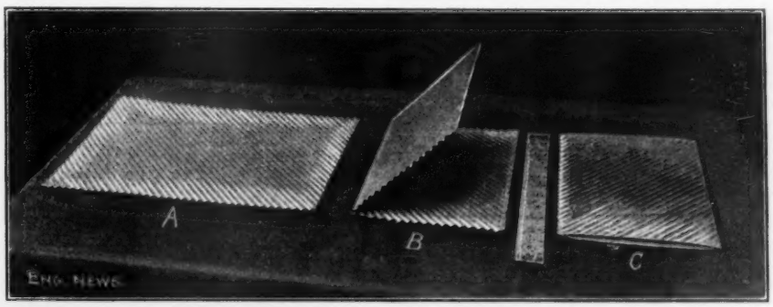

FIG. 1. SHEET OF CORRUGATED BRASS TO FORM ELEMENT OF LJUNGSTROM CONDENSER.

which both steam and water have to pass is limited to the depth of the corrugations, the result being that a very large number of fine streams of steam and water are compelled to travel a sinuous course in close proximity to each other, being only separated by the thin walls of the corrugated chambers. It will be noted that the upper part of the rectangular casing is full of steam at a pressure due to the exhaust, whilst the under side is open to the air pump, the two being separated by the packets of corrugated chambers. The steam therfore is constrained to pass along the corrugations in intimate contact with the cooling water, and with sufficient velocity to sweep with it all condensed water. The action is thus very different to that in a condenser of the ordinary type where the steam is admitted into a large chamber full of cooling tubes, and allowed to wander about until finally condensed, when it drops to the bottom and is drawn off by the air pump.

*Slightly condensed from a paper read before the Institution of Naval Architects of Great Britain.

In large condensers the evil of the steam endeavoring to take a short cut to the suction pipe is, to a certain extent, recognized, and diaphragm plates are fitted so as to compel the steam to traverse more completely over the tubes, but even then it is certain that the circulation of steam is very defective, as is shown, first, by the illustration already given of the greater efficiency of the outside condenser, and secondly, by the enormously greater efficiency of the cooling surface of the Ljungström condenser.

To compare these:

	I. HP.
Mr. Seaton—I. HP. per sq.ft. of cooling surface.	0.77 to 0.91
Simpson, Strickland & Co.—I. HP. per sq. ft. of cooling surface (outside condenser)....	2.0
Ljungström—I. HP. per sq. ft. of cooling surface (corrugated condenser)	3.5

In other words, 1 sq. ft. of a Ljungström condenser is equal to 4.5 sq. ft. of an ordinary inside condenser, or

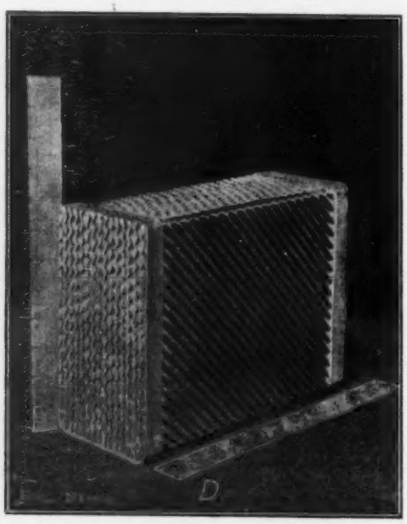

Fig. 2. Ljungstrom Condensing Unit of 15 Elements.

1.75 sq. ft. of an outside condenser. The obvious result of the great reduction in the cooling surface is a corresponding reduction in the size and weight of the condenser, and of the contained water. The fast yacht "Snowdrop II.," recently completed by Messrs. Simpson, Strickland & Co., has been fitted with the Ljungström condenser.

The total horse-power to be allowed for in the condenser is 450. The air pump is of the ordinary type, 8 ins. in diameter by 3-in. stroke, fitted with Kinghorn valves, and driven off a crank-pin on the forward end of the crank-shaft. The total weight of this machinery with steam up, and including water in condenser, worked out to 37.5 lbs. per indicated horse-power. Had a condenser of the ordinary type been fitted in place of the Ljungström, the weight would have been increased to 42 lbs. per I. HP. The ordinary surface condenser originally proposed to be fitted would have been made in thin sheet brass, and the weights kept down as low as possible. It was, however, finally decided to fit a Ljungström. The following is the comparison:

	Ordinary.	Ljungström.
Cooling surface	470 sq. ft.	130 sq. ft.
Weight, dry	18 cwt.	4.05 cwt.
Weight, with water	22 "	4.94 "
Cubic measurements	46 ft.	7 ft.

The Ljungström Syndicate guaranteed a vacuum of 22 to 23 ins. when running full power, and 27 to 27.5 ins. under cruising conditions. It was designed to condense 9,000 lbs. of steam per hr., equal to 70 lbs. per sq. ft. of active cooling surface, as against about 20 lbs. per sq. ft. in a condenser of the ordinary type. These guarantees were somewhat exceeded; the actual vacuum maintained at full power being 22½ to 23½ ins., and under cruising conditions 28 to 29 ins.

The condenser as shown has now been considerably used and has given no trouble of any kind. A recent examination and test showed everything to be clean and in perfect order. With regard to an objection that has been raised that the corrugations on the steam side will in process of time get choked up with grease, it may be pointed out that the passages are very short, and the velocity through them will tend to sweep any grease away. Moreover, there is no difficulty in boiling the condenser out with soda in the usual way, if found necessary. In any case, with the high pressures now used, the less grease used in the cylinders the better. In the engines in question, no lubricating arrangements of any kind are fitted, and no trouble has been experienced; the cylinders, pistons and valves being in perfect order, the only oil that can get into the condenser being the small amount that creeps up the low-pressure piston-rod. The detail construction of the condenser is shown in the accompanying cuts. A shows a plate after corrugation, but before being bent; B is such a plate partially bent; and C shows the plate bent up and the joint brazed, forming one element; D (Fig. 2) is a packet formed of 15 such elements ready to be fixed into the casing.

It will be noted when the plate is bent up to form an element that the inclination of the corrugations is reversed, so that on the one side they run from right to left, and on the other from left to right. In consequence the plates mutually support each other, and, further, at each crossing of the corrugations an eddy is formed in the stream passing along it, so there is no possibility of any particle of steam or water passing through without having been in actual contact with the walls. The elements after having been tinned are assembled in packets of convenient size—say about 15. A lapping of copper wire about ¾-in. long is put over each end, the packet is then stood upright in a suitable mold and melted solder run in until the outside of the corrugations are filled up to the height of the lappings.

The packet is now complete, and forms a multiple box, in which there are two series of narrow apertures at right angles to each other; horizontal passages for cooling water through the elements and vertical passages for steam between the elements. In the 450 I. HP. condenser above referred to, seven such packets are fixed in a rectangular casing. This casing is of phosphor bronze, and measures over all: Length 38 ins., breadth 18 ins., and depth 13 ins.

The question of liability to leakage and ease in effecting repairs is one of great importance, and would appear to be decidedly in favor of the Ljungström. Not only are the number of parts much fewer, but there is a complete absence of the multiplicity of packed glands, with their attendant trouble and leakage, and it is more than probable that brass, in the form of thin corrugated sheets, will be found far less liable to hidden flaws, which in time will develop into splits, than the same material when drawn into the form of tubes.

DISCUSSION.

(Reprinted from "Engineering," London.)

Mr. A. W. Brewtnall said that having been associated with others in introducing the Ljungström condenser into this country, he had naturally listened to Mr. Cross's paper on the subject with interest. After first proving the very high efficiency of this type of condenser, he felt that the jointing of the plates by solder was its one defect, as this method would not be acceptable to British marine engineers, and he had urged Mr. Ljungström to improve this detail and construct a condenser with mechanical joints. The outcome of this was the one Mr. Cross had described, an example of which suitable for an engine of 40 HP. was shown upon the table. In this the elements or tubes of any bunch could be separated for cleaning by removing the end plates. The tubes could then be easily cleaned, though the inside could not be quite so readily dealt with as the outside. The condenser shown was submitted to the Swedish naval authorities, and they at once ordered one for a despatch-boat, to be followed by others for two steam launches. In considering this question of jointing, the speaker felt that if the plates could be made singly, and coupled together in a satisfactory way, so that they could be readily separated, every part of the condenser could be thoroughly cleaned. He therefore constructed the one now shown, and which Mr. Cross had mentioned in his paper. In this the plates were stamped with the corrugations carried to within ⅜-in. of their edges, thus leaving a plain part all round. A distance-piece was then formed, of a cast rectangular frame with sides ⅜-in. wide, and of a thickness sufficient to fill in the space between the plain edges of any two plates when their corrugations were in contact with each other. Two opposite sides of these frames were serrated, to give ingress and egress to the tubes formed by any one frame with the plates at each side of it, and by placing these frames alternately with the serration, at the sides and at the top and bottom respectively, alternate passages were formed for the steam and cooling water. The frames were milled to thickness, and so formed a faced joint. The joints were tightened by pinching screws placed at frequent intervals all round, these screws being arranged in one side of the casing and pressing the assembled plates and frames against the opposite side of the casing. In putting the condenser together, the distance frames were coated with a film of thin white lead, either with a brush or by dipping, and these with their corresponding plates were stacked up in the casing, and ranged in line. The pinching screws were then tightened up equally all round. On first trial he found this method gave perfect joints at 50 lbs. pressure with either water or steam. A bunch could be taken asunder and put together again, ready for use, in about an hour's time.

Professor Weighton also criticised the soldered joint.

In reply to the discussion, Mr. Cross said that the soldered joint was not altogether to be condemned, for in a condenser which had worked 20 years, in only one spot had the solder given way. With regard to the objection raised as to the possible deposit of scale, that was a matter which time would prove; but it was quite as easy to clean these plates as to clean the inside of condenser tubes. As to cost, his arrangements would not exceed that of a first-class marine condenser.

THE CAMPANILE OF ST. MARK'S, in Venice, Italy, which fell some months ago, is being rebuilt, the cornerstone of the new tower having been laid on April 25. The fall of the old tower has been reported on by a commission appointed by the Minister of Public Instruction, and their report has recently been made public. The questions submitted to the commission were, first, what were the causes of the collapse, and, second, who is to be charged with responsibility for the accident? In reviewing the history of the tower, the commission finds that the lower part was built of grouted filling between inner and outer walls of masonry; that the numerous repairs made in the seven centuries since the structure was begun were usually quite inadequate, and that as the grouted filling had gradually come to carry a good part of the load, the structure for years past was in dangerous condition, so that when the eave-cornice over the Sansovine loggetta was cut out of the outer wall (a few days before the fall) it was weakened enough to produce cracks in the tower, which soon resulted in its collapse. The commission places the responsibility for the accident on the two bodies who had jurisdiction over the structure: the local building department and the cathedral building bureau. These authorities are charged with having neglected to examine or give any care to the structural condition of the tower.

THE 15-CU. YD. DIPPER DREDGE FOR THE NEW YORK HARBOR IMPROVEMENTS.

The largest and most powerful dipper dredge in the world is now being operated by Hughes Bros. & Bangs, the contractors for deepening the Bay Ridge Channel in New York Harbor. This

FIG. 1. GENERAL VIEW OF 15-CU. YD. DIPPER DREDGE FOR THE BAY RIDGE CHANNEL IMPROVEMENTS, NEW YORK HARBOR.

Osgood Dredge Co., Albany, N. Y., Builders; Hughes Bros. & Bangs, Syracuse, N. Y., Contractors.

dredge has a dipper capacity of 15 cu. yds. and will dig to a depth of 50 ft. It is also designed and equipped to operate a 10 cu. yd. dipper and a 12 cu. yd. clam shell bucket. When using the 15 cu. yd. dipper the dredge has records of 6,000 to 8,000 cu. yds. excavated per day and of 105,000 to 120,000 cu. yds. per month, all at depths of

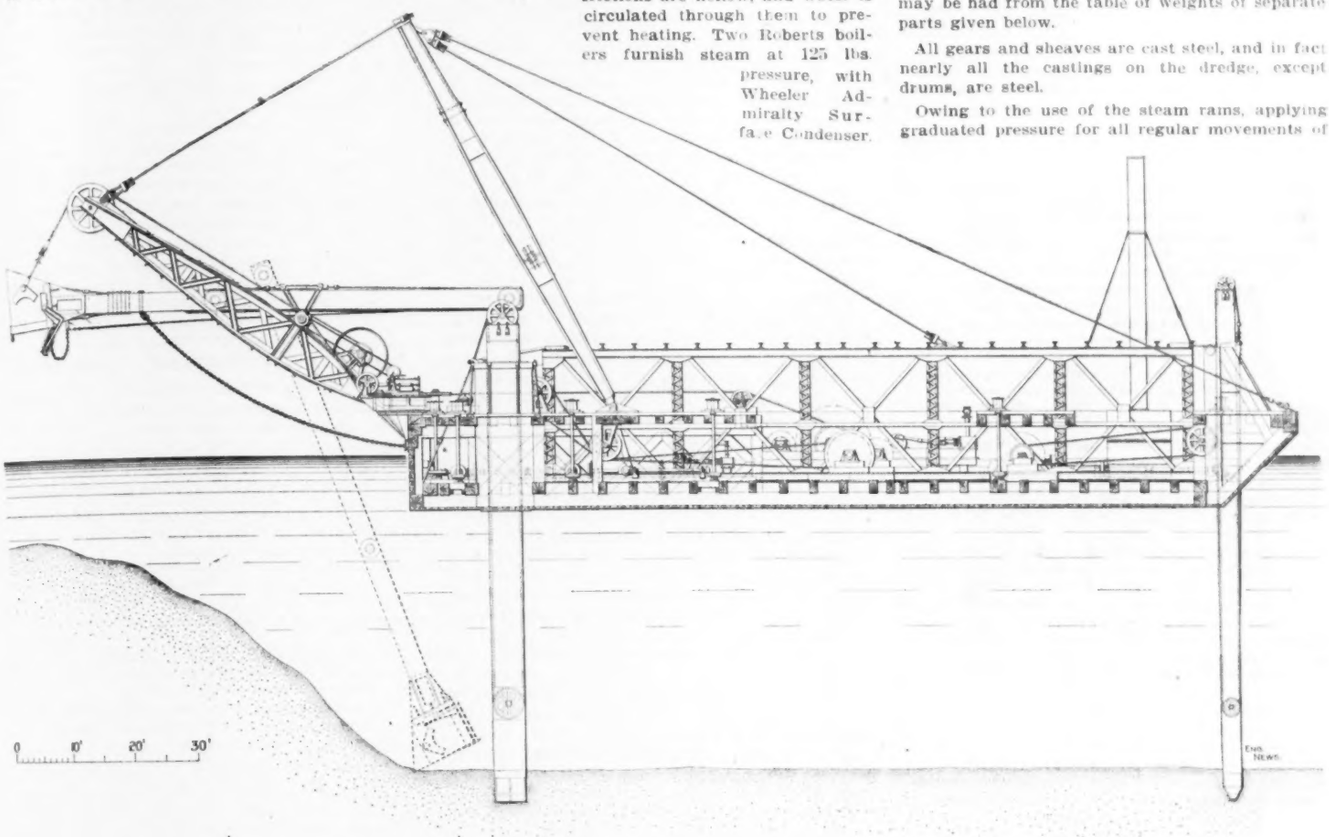

FIG. 2. LONGITUDINAL SECTIONAL ELEVATION OF 15-CU. YD. DIPPER DREDGE.

42 to 48 ft., and much of the time in hard packed sand. Fig. 1 is a view of the dredge in working order and Figs. 2 and 3 are general plans and elevations showing the main structural features and the operating machinery.

HULL AND STRUCTURE.—The hull is rectangular in plan and is 140 ft. long, 50 ft. wide and 15 ft. deep. It is constructed entirely of Oregon fir and Georgia pine. Figs. 2 and 3 show clearly the keelsons, floor beams and other framing and also the character of the sheathing. To stiffen the hull there are two parallel steel trusses which run practically the whole length between spu wells. There are four of these wells, two at h

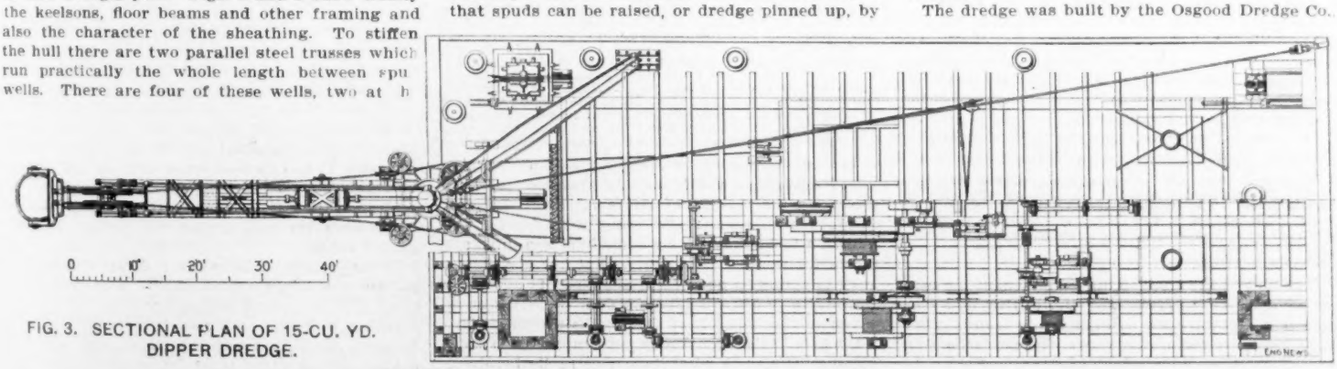

FIG. 3. SECTIONAL PLAN OF 15-CU. YD. DIPPER DREDGE.

bow and two at the stern. The forward spuds are 5 ft. square and 80 ft. long and the rear spuds are 3 ft. square and 85 ft. long. Each spud is built up of four sticks of Oregon fir bolted together and heavily plated. The A-frame is of steel and stands 70 ft. high above the deck. It is anchored by one pair of wire cables to the top chords of the stiffening trusses and by a second pair to the stern post of the hull. The boom is also of steel and is 60 ft. long, with a pair of 8-ft. sheaves at the end.

OPERATING MACHINERY.—The main engine is 20½ × 24 ins., with links and steam reversing gear, and is compound geared, 12 to 1. The two hoisting drums are 60 ins. diameter on 11-in. shafts, with cone frictions 12 ft. in diameter set up by steam rams which apply graduated pressure under control of the runner. The female frictions are lined with lignum vitæ, and the male frictions are hollow, and water is circulated through them to prevent heating. Two Roberts boilers furnish steam at 125 lbs. pressure, with Wheeler Admiralty Surface Condenser.

The dipper handle is made of one stick of Oregon fir, 36 ins. square and 80 ft. long, and has a 36-in. sheave at each end. Its longitudinal movement is controlled by wire ropes running over these sheaves, and around sheaves on a shipper shaft to a drum fitted with a brake band operated by a graduating steam ram on the turntable. Each spud has sheaves at top and bottom, over which run wire ropes to friction drums with band brakes, so that spuds can be raised, or dredge pinned up, by reversing the engines. The forward spuds are handled by the main engine and the after spuds by a 12¼ × 15-in., double cylinder, auxiliary engine, and both frictions and brakes of all four spuds are operated by graduating steam rams.

There are 11 capstans for handling scows, five on each side and one at the stern. The six forward capstans are driven by an auxiliary 12¼ × 15-in. engine, and each one is fitted with independent friction and brake. The three after capstans are driven by the after spud engine and have no frictions.

The cables are Roebling's plough steel, 37 wires to the strand. The hoisting cables are 2 ins. in diameter, top spud cables 2½ ins., the bottom spud cables 1¾ ins., two to each spud, and the dipper handle cables are 1½ ins.

The total weight of machinery of the dredge is over 500 tons, and some idea of its massiveness may be had from the table of weights of separate parts given below.

All gears and sheaves are cast steel, and in fact nearly all the castings on the dredge, except drums, are steel.

Owing to the use of the steam rams, applying graduated pressure for all regular movements of the dredge, it is operated as easily and quickly as small dredges. The average speed in 45 ft. to 48 ft. of water is one dipper per minute, but in soft digging it has often loaded scows at the rate of one dipper every 45 seconds. The time occupied in raising spuds, moving up, and pinning up on spuds, is seldom over two minutes and frequently only one minute. The length of move is from 15 to 20 ft.

The dredge was built by the Osgood Dredge Co. of Albany, N. Y., and we are indebted to its officers for the information from which this description has been prepared.

Weights of Separate Parts of Dredge.

	lbs.
10-yd dipper	45,000
15-yd. dipper	35,000
12-yd. clam shell	40,000
Hoisting drum, gear friction and shaft	60,000
Turntable	46,000
Boom	50,000
A-frame	40,000
Forward spuds, each	130,000

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It is beyond question that there is no commodity which is bought and sold in so crude a manner as labor, and particularly labor in the higher grades. The buying and selling of other goods has become a highly systematized process; but in the purchase and sale of labor our economic system is still remarkably deficient.

It is safe to say that there are thousands of enterprises now being carried on at a loss merely because of the incompetence of the managers, superintendents, engineers, foremen or other officers charged with responsibility for their conduct. It is equally safe to say that somewhere there are men working in subordinate positions who have the ability to transform these losing ventures into paying ones.

We are led to these remarks by the receipt of the following inquiry from a Texas subscriber:

> In each issue of your valuable paper I notice advertisements of engineering agencies or bureaus who offer to secure position for engineers, draftsmen, etc. I would be very much obliged to you if you can give me some expression as to how an engineer is regarded who secures a position through that means. Would one lose his good standing in the profession?

The aim of the engineering employment bureaus or agencies is to systematize the buying and selling of a certain class of high grade labor. They constitute a clearing house where those who seek help and those who would offer services can be brought in contact with each other.

The need of such institutions has become particularly great on account of the specialization of modern industry. Suppose, for example, that a company is organized to manufacture a new article of pressed steel. The company consists of the inventor and his financial backers, and they want a man with sufficient experience in other lines of pressed steel manufacture to undertake the management of their enterprise, build their shops, equip them with machinery and carry on the business. The concern's success will depend very largely on finding the right man for the place; but the task of finding him is a most difficult one. Out of 500 mechanical engineers who are either out of a place or seeking a better position than their present one, there may be not more than half a dozen with the necessary knowledge and experience of the pressed steel business, and even these may lack the desired executive ability. Yet it is almost certain that somewhere there is a man who could exactly fill the requirements.

It must be acknowledged that the day of the all-around engineer is passing. Specialization is the order of the day. It is often far easier for the young engineer just out of school to obtain a position than it is for his brother with ten or twenty years' experience. The young man is available for any subordinate position, while the man with long experience in one line of work is practically tied up to that. He has grown rusty in other lines and would have to begin over again at the bottom were he to undertake them.

It is not necessary to discuss the matter further to make it clear that some organized system of bringing together engineers and those who desire to employ them is becoming more and more necessary. A number of people are carrying on this work as a private enterprise for profit. It is also being done by some of the engineering societies for their own members. There is absolutely no reason why an engineer's professional standing should be injured through registering with such a bureau, either coöperative or commercial. It may be said that lawyers and physicians do not have to resort to such means to obtain positions; but the rank and file in these professions do not hold salaried positions. If we turn to other professions, we find that teachers are largely employed through agencies, and the same thing is more or less the case, we believe, with clergymen.

The engineering employment bureaus are here to stay, unquestionably, and there is really nothing save prejudice and the persistence of old ideas to injure any man's reputation in seeking their aid in securing a position.

Of course, the caution should be given that none of these bureaus can give satisfaction to either class of clients unless their reputation is sufficient to invite the patronage of good engineers on the one hand and of a good class of employers on the other.

A bitter attack upon concrete as a material for fireproof buildings is made in the April number of the "Inland Architect." We hesitate to impugn the good faith of our contemporary, but the fact that in the same breath in which it condemns concrete it holds up hollow tile as the ideal of perfection is certainly significant. We quote as follows:

> The folly of using obsolete methods to carry out modern design is nowhere more forcibly exemplified than in the too prevalent practice of fireproofing by the use of concrete. . . . . The accidents that have attended such construction throughout the country show that its fireproofing quality is offset by its dangerous instability. . . . . When the fireproofing experts of the country have for 20 years studied the application of hollow tile to the modern methods of building and the lightness of structure and the required elasticity of frame are secured, so that there is no action under fire and water tests, then the futility of using other methods seems unquestionable.

Is our contemporary speaking as an unprejudiced adviser of the practising architect, or is it imitating the practice of the disreputable class of trade journals and permitting its editorial expression to be dictated by some business interest? We shall assume the former—that our contemporary is acting in good faith and that its advice to architects to discard concrete floor construction is given in the belief that that is the proper policy.

On this basis we ask our contemporary to consider a little as to what its advice really involves. It has in mind, doubtless, when it compares concrete and hollow tile construction, such structures as office buildings, stores, schools, libraries, hotels, buildings for public assembly and the like. But suppose there walks into the office of one of the architects whom our correspondent seeks to advise, a client who wants a building of an entirely different sort. It is perhaps a building for heavy manufacturing; a paper mill, or a sugar refinery; or perhaps it is a heavy warehouse. The floors must carry heavy machinery and must stand up uninjured notwithstanding the effects of vibration, of shock, or of heavy loads rolled over them or dropped upon them. Very likely in addition it is required that the floors shall be waterproof.

Will the "Inland Architect" go so far as to claim that hollow-tile construction is the only thing to use in such buildings and that concrete has no claim to consideration? If it can take this ground, in the face of the numerous examples of successful concrete buildings for heavy manufacturing built in the past half-dozen years, then its reputation as a disinterested adviser of its readers has surely departed.

If our contemporary is sincere, it must acknowledge that in buildings for heavy manufacturing and storage purposes hollow tile is wholly out of place and concrete is undoubtedly the material to use at the present day. But with this admission made a further step must be taken. If concrete is better for the heaviest class of buildings, where the severest service and the greatest stresses are sustained, is it logical to turn it down as unsafe in buildings where the loads and stresses are far smaller?

THE LAKE ONTARIO ROUTE FOR A BARGE CANAL.

As our readers will remember, Engineering News has strongly urged that if the state of New York should decide to undertake the construction of a thousand-ton barge canal from the Lakes to the Hudson, it should be built by the Lake Ontario route, and not by the inland route, which is now proposed. Quoting from the report of State Engineer Bond on the barge canal survey of 1900:

> The main advantage of the lake route is a saving in cost of construction. The next advantage is increased speed. . . . On the lake route there will be only 48.5 miles of standard canal section, 104 miles of canalized river section and 195 miles of open water. . . . On the round trip between Troy and Buffalo with power for a 3-mile per hour canal speed, there would be a gain of 35.5 hours for a barge and consort in favor of the lake route. The item of annual maintenance would practically be nothing on the 195 miles of open water navigation and is therefore another factor in favor of the lake route.

The organization which has been pushing the canal scheme, however, would hear nothing of the Ontario route. They turned a deaf ear to all the well known advantages of natural waterways as compared with artificial channels, declared that the barge canal must be built by the inland route and succeeded in forcing their scheme through the legislature in this form.

Their ostensible reason for this was that the navigation of Lake Ontario is too dangerous for 1,000-ton barges of cheap construction, such as are proposed for the 1,000-ton barge canal. The real fact of the matter is that the Buffalo interests would not favor the barge canal until they were assured that it would not in any way permit freight to pass through Buffalo without transfer.* The barge canal advocates, therefore, continually harp on the idea that the 1,000-ton barges are to be of exceedingly cheap and flimsy construction, and wholly unfit for Lake navigation. The Lake Ontario route was turned down because if it were once admitted, that canal barges might sail a hundred miles on Lake Ontario, it would be evident that they could continue their journey to Lake Erie ports or even to the Upper Lakes and bring freight through to tidewater without breaking bulk. It will be obvious to any one that a considerable increase in the first cost of a vessel is a trifling matter if by that increase she is enabled to make a through voyage and save a transfer of her cargo.

If the voters of New York decide in favor of a 1,000-ton barge canal scheme next November, they will do it, unquestionably, with the idea of creating a great economic transportation route between the Lakes and the Ocean, and not with a view of benefiting those interested in the business of freight transferring at New York city and Buffalo. The voters should understand, therefore, that this result at which they aim—this great water route connection between the Lakes

*In the legislature of 1902, the Buffalo interests opposed the 1,000-ton barge canal. They wanted to either improve the present canal or else adopt the scheme of Mr. Geo. H. Raymond, a prominent owner of grain elevators in Buffalo. This scheme was to merely widen the locks of the present canal to take boats of 25 ft. width and 125 ft. length with a draft of only 7 to 8 ft. It was entirely certain that canal boats of such a model would not be caught navigating the lakes.

and the Ocean—can be attained with little more than half the expenditure which is called for by the $101,000,000 barge canal bill, simply by adopting the Ontario route.

As we said above, the Ontario route was turned down by the canal promoters on the ground that the navigation of Lake Ontario was too dangerous for 1,000-ton barges, and because of this the voters of the state are asked to sanction the expenditure of more than $30,000,000 additional to build an inland canal, requiring a longer time to build and to navigate, and costing much more to maintain. We now have the pleasure of presenting the strongest kind of evidence that Lake Ontario is not unsafe for such barges. It is in the form of an official report by the Deputy State Engineer, Mr. Wm. Pierson Judson, M. Am. Soc. C. E., made to State Engineer Bond, and published in his official report for the year, just ready for issue. It would be difficult to find anywhere a man better qualified to speak with authority on the subject of Lake Ontario navigation than Mr. Judson. He was for nearly 18 years connected with the United States Engineer office at Oswego, and was in charge of a great amount of work on Ontario harbors during that time. We print Mr. Judson's report as follows:

Hon. Edward A. Bond, State Engineer and Surveyor.

Dear Sir: In consideration of the routes for the 1,000-ton barge canal from the Hudson River at Albany to the upper lakes at Buffalo, the Mohawk-Oneida-Oswego Rivers via Olcott line is shown at page 52 of your Barge Canal Report of 1901 to cost $54,700,000 or $32,000,000 less than the similar enlargement of the present Erie Canal.

This great financial advantage results partly from the lesser number of bridges, but it mainly results from the fact that this line includes navigation of Lake Ontario for 110 miles from the harbor at Oswego to the harbor at Olcott, from which point on Lake Ontario there have been numerous surveys for ship-canal lines to reach Lake Erie at Buffalo.

In connection with the obvious advantages of this open-water navigation, it is desirable to describe the harbors along the south shore of Lake Ontario which would serve as places of refuge for tows of canal barges of 10 ft. draft and 1,000 tons capacity using this route.

The south shore of Lake Ontario, in the distance of 110 miles between Olcott and Oswego, has seven United States harbors, including the two first named, and with all of these harbors the writer is familiar, having, as United States Assistant Engineer, made repeated surveys of all of them at various times between 1869 and 1897, while in charge of their works.

In addition to these harbors which are maintained by the general government, there are three lighthouses on points which have no harbors. The safety of boats navigating this part of Lake Ontario is thus amply provided for, especially in view of the further fact that this portion of Lake Ontario offshore is entirely free from shoals and islands; the open lake being 400 to 600 ft. deep and there being no shoals or islands in it, except a shoal at the mouth of the Niagara River, 18 miles west of Olcott, and shoals and islands at the extreme easterly end of the lake, 30 to 50 miles beyond Oswego.

Mr. Judson then gives a description of each of these harbors in detail. We need only say here that a tow of vessels passing from the mouth of the Niagara River to Oswego would be at no time in its voyage more than 11 miles distant from a place of refuge in case of sudden storm. Over most of the distance the harbors are only about 15 miles apart. Mr. Judson then continues as follows:

The creation of this canal route by way of Lake Ontario would in no way contribute to the Canadian commerce by way of the St. Lawrence, but would solely benefit the commerce of New York State by way of the Hudson River to New York. That it would not benefit Canadian commerce is evident when it is considered that the Canadians already have the Welland Canal with 2 ft. greater depth and with much larger locks than proposed, by which commerce now has full access to the St. Lawrence route.

From a common point in Lake Erie, 17 miles up the lake from Buffalo and opposite to the entrance to the Welland Canal, the distance to be traversed to a common point in Lake Ontario opposite to Olcott is practically the same, being 66 statute miles by way of the Welland Canal, and 63 statute miles by way of the Niagara River and the proposed barge canal and Olcott.

LAKE NAVIGATION.—It has already been proven by actual experience that 240-ton boats, built to navigate the present Erie Canal, can safely be towed on Lake Erie and can be used in traffic from the ports on Lake Erie to Buffalo. This fact being established, it is evident that boats for the proposed 1,000-ton barge canal, being four times as large as the present Erie Canal boats, can with equal or greater safety navigate Lake Ontario, which is more favorable for navigation than Lake Erie; Lake Erie being comparatively shallow, 40 to 90 ft. in depth, and more quickly disturbed by storm, while Lake Ontario is 400 to 600 ft. deep and less easily affected.

With the numerous harbors which have been described, there is no question that 1,000-ton barge canal boats can be towed with safety during the canal season (April-November) through Lake Ontario to Oswego, from which the greater part of the route to the Hudson River will lie through the open waters of the Oswego and Oneida Rivers, Oneida Lake and the Mohawk River.

It is worthy of consideration that when it is undertaken to enlarge the Erie Canal by way of Oneida Lake and the Oneida and Seneca Rivers to Buffalo, such enlargement will take many years as well as many millions; meantime by merely enlarging the Oswego Canal and Oswego River for 20 miles from Three-River Point down to Oswego, commerce can use this route and get into Lake Erie by way of the Welland Canal many years before they will be able to use the other route through the center of the State.

Very truly yours,

Wm. Pierson Judson,
Deputy State Engineer of New York.

To add further force to Mr. Judson's report, we have now the action of Canada in abolishing tolls on the Welland and St. Lawrence Canals on May 1, thus making it unnecessary for New York to build a separate canal from Lake Erie to Lake Ontario. It thus becomes possible for New York by an expenditure of less than $50,000,000 to open a 12-ft. channel from the Lakes to the Ocean by the shortest route in point of time across her territory. If a 1,000-ton barge canal is to be built, every consideration of sound business principles and common sense would indicate that this route should be built upon first. The work upon it is actually all included in the $101,000,000 bill passed by the legislature, and what we urge is merely that this part of the work should be undertaken and completed first and that the remainder of the work should be postponed until this is done and its results are ascertained.

There is the strongest reason to believe that the Ontario route would furnish as economical transportation as could be furnished by a canal on the inland route, and if this were found to be the case, the State would be saved the needless outlay of $40,000,000 to $50,000,000.

PROGRESS TOWARD THE UNION ENGINEERING BUILDING.

We record on another page of this issue the progress made toward the realization of the great project for a Union Engineering Society House, made possible through the munificence of Mr. Andrew Carnegie. It will be seen that the governing bodies of four out of the five societies concerned have already selected delegates to represent the Society in a joint conference committee to take action with reference to the acceptance of Mr. Carnegie's offer.

As we stated last week, the only society concerning whose cordial coöperation there appeared any possibility of doubt is the American Society of Civil Engineers, due to the fact that it already possesses its own house. To test to some extent the sentiment of the membership of the American Society of Civil Engineers toward the project we sent out last week circular letters to forty well-known members of the Society, asking from each of them a brief expression of opinion upon the question: "What action should the American Society of Civil Engineers take with reference to Mr. Carnegie's offer?" From the responses to the letters thus far received, which we print in another column, it will be seen that the sentiment is practically unanimous in favor of hearty and cordial coöperation with other societies in carrying out the great project which Mr. Carnegie has made possible.

During the fortnight which has elapsed since the project for a Union Engineering Building became public, the daily papers have made frequent references to discord among the societies. Such headlines have been frequent as "Engineers at Odds," "Hitch Over Carnegie Offer," "No Union for Engineers," etc. It seems to us that every engineer with proper pride in his profession must have felt mortified at such publications. They are, we believe, distinctly hurtful to the reputation of the profession at large. It is frequently charged that the typical engineer is so pertinacious in clinging to his own opinions, and so unable to carry on that give and take and compromise which must be the basis of any joint action by a body of men, that he is unfit for executive positions. Whatever foundation there may have been in the past for such charges, we maintain that they are wholly unwarranted at the present day. The great number of prominent engineers holding positions of large executive responsibility is sufficient answer to this charge. In the carrying out of almost any work of great magnitude at the present day, the coöperation of engineers belonging to several different branches of the profession is necessary, and such coöperation is practised day after day without jealousy or difficulty. Why then should there be any difficulty in the organizations representing the different branches of the profession uniting in action for the common welfare?

A thought expressed in some of the letters which we publish is that in abandoning its present independent home the American Society of Civil Engineers will be making a sacrifice, which it is its duty to make, however, for the general welfare of the profession at large. We believe a more thorough study of the subject will show that the change will actually result to the great advantage of the American Society of Civil Engineers, and this opinion, indeed, is emphatically expressed in several of the letters which we publish.

What is the house of a national engineering society for? To furnish headquarters for its executive organization, a place for holding its regular meetings, accommodations for its library and other belongings, and a rendezvous for its members permanently or temporarily in the city. Each and every one of these ends can be far better met in a great million-dollar building, such as Mr. Carnegie has offered to erect, than could possibly be done in any building within the financial resources of any one Society.

Take for example the auditorium. This room in the present Civil Engineers' house is confessedly a failure in its acoustic properties, and while it is sufficiently large at present for the fortnightly meetings, at each annual meeting or at any occasion of unusual interest, it is far too small to accommodate those in attendance. Thus the Society has the alternative of excluding a considerable part of its members from participation in the meeting or going to the large expense of renting some outside auditorium, often inconvenient and ill-suited to the uses of the Society. The same difficulty occurs when it is attempted to use the house for some social function. Its inadequacy is then forcibly apparent.

But it may be said the Society is strong enough and rich enough to build a house of any size it needs. Admitting its ability to do so, the question arises whether it would be a wise or commendable use of the Society's funds—raised, it must be remembered, by a general tax on members of whom the great majority are men of moderate means—to do such a thing. Is it not absurd on its face to invest a vast sum of money in something which will be used only once to half a dozen times in the course of a year?

We recall Mr. E. H. McHenry's admirable definition of engineering as "The Art of Making a Dollar Earn the Most Interest." Ought not engineers, for the sake of the reputation of the profession, if nothing else, to conduct their own affairs with the same business ability that they are supposed to give to the conduct of other people's?

We do not know a single purpose served by the present Society House which could not be furnished equally as well or far better in a great Union Engineering Society Building. So far as the library is concerned, the members will without doubt gain access at once to the libraries of three other great engineering societies besides their own, and will have besides the advantage of the great New York Public Library only a few steps distant.

We might say much more as to the direct advantages which would accrue to the American Society of Civil Engineers from the proposed coöperative action with its sister societies; but we believe the better and juster point of view from which to consider the matter is the interest of the

profession as a whole. Mr. Carnegie's generous offer is coupled with no conditions; but its spirit is that of beneficence to the profession at large. The title to the new building will doubtless vest in the five societies named by him in his offer; but these societies ought to and we feel sure will regard themselves as trustees of a great benefaction to the profession at large.

The Union Engineering Society House should be and doubtless will be the great focus of engineering activity in New York city. The use of its auditorium should be afforded to other national engineering societies holding meetings in New York city, such as the Naval Architects, the Railway Engineering Association, the Society for Testing Materials, the Engineering Education Society, and numerous other organizations. Here will be the ideal place in which to welcome the great foreign engineering societies whenever their members visit this country to hold meetings.

Local engineering societies should also be afforded room in the building. In short, the whole aim should be to make it a center of the greatest usefulness to and influence in the profession. In doing this its value to the members of the four great national societies will be much enhanced. A member going to the building on almost any evening in the week would find some sort of engineering meeting in progress in some of the auditoriums which he could attend if he desired, or if he wished the relaxation of meeting socially other engineers, he would be certain to find friends and opportunities to enlarge his circle of acquaintance to an extent impossible at the headquarters of any single society house.

Around this building also, we may be sure, will grow up a center of engineers' offices and a headquarters for firms dealing in engineering materials and supplies. Thirty-ninth St. a dozen years hence will be as populous with engineers as is Great George St., in London, hard by the headquarters of the Institution of Civil Engineers. The influence of such a national engineering center on the reputation and welfare of the profession in all its branches it would be almost impossible to overestimate.

In this movement for coöperation, members of the American Society of Civil Engineers have taken a foremost part. The name of this Society was placed at the head by Mr. Carnegie in making his formal offer. In view of the strong sentiment in favor of coöperation expressed by prominent members of the Society in this issue, we feel there can be no room for doubt as to the Society's favorable action.

LETTERS TO THE EDITOR.

Conversion of Square Feet into Square Yards.

Sir: Referring to your correspondence columns of April 30, I would say that to those who find the mental process of successive additions easier than that of division, it would seem simpler to divide successively by ten and then add the quotients. Thus to divide 763.0 by 9:

76.30
7.63
.763
.0763
.00763

84.77693

This process is well adapted for use with the comptometer. Personally the writer finds the process of dividing successively by 3, twice for the conversion to square yards and three times for the conversion to cubic yards, to be very easy mentally, which, to him, the dividing by nine is not.

Horace Andrews.

High Temperatures in Boiler Furnaces and Mechanical Stokers.

Sir: Your correspondent, J. Jay Dunn, in your issue of April 16, asks why tubes in boilers (presumably water-tube boilers) fired by mechanical stokers, fail oftener than is the case when hand-fired furnaces are used. The reason is that the stoker usually makes a larger fire than is obtained when the fires are supplied by hand. The man who shovels coal into a furnace may be lazy or not physically strong enough to work the furnace to its full capacity, or he may be a member of the union and believe in the minimum amount of work for the maximum wage. The mechanical stoker, however, is operated by power which is ample and continuous, and the result is a steady and stronger fire.

The reason that tubes of water-tube boilers fail is because they are not clean or in some designs because the water supply in the lower rows is not sufficient.

It would appear that the writer of the inquiry considers a high furnace temperature objectionable, but good efficiency can only be had with high initial temperature, as represented by the equation

$$E = \frac{T^1 - T^2}{T^1}$$

T^1 being the initial or furnace temperature and T^2 the final or temperature of escaping gases.

A. Bement.

218 La Salle St., Chicago, May 4, 1903.

The Duluth Concrete-Steel Elevator: Why Did It Fail?

Sir: Having noted in this week's issue (April 30) your description of the failure of the concrete-steel tank at Duluth, the writer would suggest a question regarding the theory of failure offered. Was it caused in a manner similar to the previous one, as you assume? The probability is that it was, providing the interior bin was filled and the exterior one empty. On the other hand, the writer has been advised that the exterior and interior bins were filled to about the same depth, and, further, that there has been a certain amount of unequal settlement of the foundation which, if yielding in the least under the great weight of the varying loads, would cause enormous shearing strains in the walls, tending to gradually crack the concrete vertically and loosen the straps. The tensile stresses would then be carried wholly by the steel, and as the 1½ × ⅝-in. straps were but indifferent spliced (see Eng. News of Dec. 27, 1900), failure might result from grain pressure in the circular bin.

This objection to joining or grouping the bins, as was done in this design, was called to the owners' attention shortly after the failure of three years ago, with the suggestion that independent bins were more suitable for the location.

Whether the information given in your description of the failure or that given to the writer is correct, he is unable to say, further than that the appearance of the last break would seem to indicate the theory suggested rather than that assumed by you. Yours truly,

C. A. P. Turner.

816 Phoenix Building, Minneapolis, Minn., May 6, 1903.

(Since the above was put in type we have received a second letter from Mr. Turner, from which we quote as follows:—Ed.)

On May 9, I visited the scene of the accident at Duluth and was advised that at the time of the failure on April 15 the grain in the interior bin and the circular bin was at approximately the same level, which seems to upset the explanation given.

About a week after the failure referred to another bin failed; this time an exterior circular bin, the break being outside or connecting link to the interior bins and impossible to attribute to their influence.

Since the failure in 1900, due care has been taken to keep the level of the grain in the interior bins not greatly above that in the circular bins, I am informed. The failures, then, must be attributed to the combined effect of the stresses set up by the varying loads on a somewhat yielding foundation and the considerable temperature stresses due to the objectionable feature of connecting so many bins together.

C. A. P. Turner.

Minneapolis, May 11, 1903.

Removing Piles by Blasting.

Sir: Kindly allow me to contribute to the matter of pile blasting published in your issue of April 16.

During the spring of 1902, we had standing alongside of a steel bridge, just then erected, the remains of a temporary pile bridge across the Goulais River. Deck and caps had been removed and only the piles were standing. The spring break up came earlier than expected and on the float ice, on which they had been skitted, came many thousand feet of logs. A jam was formed at once, filling and damming the river. It devolved upon the writer to remove the obstruction as quickly as possible and break the jam. There was on hand, 40% dynamite, telegraph wire, a battery; electric fuses with waterproof insulation were sent for by special. Of the telegraph wire, rings were formed, large enough to slip over the pile; on each ring were fastened in three separate places a half stick of dynamite, with a percussion cap in each. The wire, after being prepared, resembled very much a pyrotechnic pinwheel. These wire rings were let fall over the pile with sufficient fuse to reach the river bottom, were then connected with the battery and in less than 12 hours the river was open and the logs moving. None of the piles splintered, they all cut off clean and sharp at the bottom. This is the most rapid, as well as cheapest way of removing piles out of a stream bed. Yours truly,

G. W. Stadly, Engr. M. of W.

The Algoma Central & Hudson Bay Ry. Co., Sault Ste. Marie, Ont., April 28, 1903.

(In our issue of April 16 the blasting of large white oak piles was described, and with such piles 40% dynamite was ineffectual. Our correspondent doubtless had pine or spruce piles to contend with, and in such cases low grade dynamite will cut off the pile. In Eissler's "Hand-book of Modern Explosives," p. 226, pile blasting is discussed briefly, and an instance given of the cutting off of a 12-in. pile by means of one cartridge (1 lb.) of dynamite fastened to a wooden hoop, which was forced down over the pile by two long wooden poles fastened to the hoop. Our correspondent's use of telegraph wire for the hoop is a decided improvement, since its weight will hold the dynamite at the bottom of the pile without the use of poles.—Ed.)

An Architect's Rhyme.

Sir: The inclosed, depicting the troubles of the architect, and which is more than founded on fact, might form a fitting companion to "Meest McDonough's Bias'" and "The Woes of the Section Boss."

The whims of this particular client are by no means an exaggeration, and I think that most architects could tell a similar tale with the difference in local coloring only. Yours truly,

Franklin M. Small.

265 Broadway, New York, April 27, 1903.

THE ARCHITECT'S PLAINT.

We have laughingly read of McDonough's great bias,
And with sorrow sincere of the Section Boss' Woes,
Though their trials were great, yet none could surpass
The real tribulations the Architect knows.

His woes are indeed of complex composition,
Though covered, 'tis true, with a saccharine coat,
And date from the day he secures his commission,
As he struggles the whims of his client to note.

The client, who once on a time went abroad,
And trotted through palaces stately and grand,
Feels sure that the "Classic" is just in accord
With his superfine tastes and the cash at command.

What? Classic, indeed! not for me; you should know,
Says the good wife who shares in his joys and his cash.
Let us have something grand in the style Rococo;
Something with character, movement and dash.

The Architect now bravely faces his fate,
Each friend and relation has plans to suggest,
And they argue them early and argue them late,
As to which is the poorest and which is the best.

As for style, they advise the Pompeiian or Greek,
Louis Quartorze perhaps, or Flemish from Flanders,
French Renaissance, if tone he would seek,
Or Francois Primiere, with its queer Salamanders.

Now with all these suggestions so ready to hand
The Architect sure will an easy task find
In producing results of superior brand;
A subduing of matter, a triumph of mind.

His work is complete; those who lighted his way
(The Architect pauses, amazed, holds his breath),
They abuse him by night and decry him by day,
And all of them join in to stone him to death

The Essentials of a Successful Automatic Stop System for Railway Signals.

Sir: The "Literary Digest," quoting from an editorial in the "Scientific American," says that "in this country seventy-seven have perished in fifteen days" as the result of railway collisions. In comparing the situation in this country and in Great Britain, speaking of the few casualties in that country, they go on to say: "This is not because the signaling systems are better, for many of the roads on which our worst accidents have occurred have more perfect visual signal systems than are in use on the British roads." They add the opinion of "an eminent American engineer who accounts for this difference, by saying "that it is one of national temperament"; that "here, we take chances."

The "Scientific American" accepts this explanation and goes on to say that "the remedy must evidently lie in automatic devices that will not allow the engineer to take chances," further on expressing the opinion that such devices are obtainable, "the only obstacle to putting them in operation being one of expense," and quotes from Matthew's gospel "How much then is a man better than a sheep?"

Having had several years of practical experience in railroad and signal work, most of which time has been spent in working out the problem which the "Scientific American" goes on to settle (on paper), I feel entitled to express an opinion upon this subject, and say that I do not agree with that journal that "the only obstacle to putting them in operation is one of expense." It is rather one of suitable apparatus.

Few men who have not given this subject long and exhaustive investigation can appreciate the mechanical difficulties to be encountered. Not one man in a thousand if asked where is the only point of clearance, below the rail tops will answer correctly. Since there is but one point of clearance and that utterly impractical for the use of a tripping device, such as suggested by the "Scientific American," it follows that nothing below the top of the rail can be used; while anything moveable projecting above the top of the rail is liable in its erect position to catch or trip something upon the locomotive, car, or snow-plow which might not prove as flexible as desired or as the companion valve-trip upon the locomotive, and the higher it projects the greater the risk.

On busy roads (where most needed) in snowy countries, its necessarily frequent movement would soon pack the falling snow or forming ice so as to prevent its full and, therefore, safe movement. When the traffic is light and the operation infrequent, freezing might cause it to remain in its lowered or normal safety position, unless operated by sufficiently powerful devices to break it away from its icy fastenings, a condition impracticable anywhere "out on the line" where such power is unavailable. In yards and near signal towers, hand-lever or air-pressure operating devices could be used, and in such places the apparatus could possibly be kept clear of ice and packing snow as is now done at switch points and frogs, an utterly impractical thing on more remote parts of the road where many of the most serious accidents happen.

Another serious drawback to be considered is the strength of tripping apparatus for surface roads, where conditions are quite different from those that exist in operating elevated trains at not to exceed 25 miles an hour. The blow struck by a train at 25 miles an hour is trivial compared with a blow at 60 to 80 miles an hour.

The usual method of operating automatic signals away from signal towers, which are always manually operated, is by electric battery power. Such power is obviously inadequate to move apparatus which can withstand a blow from a high-speed train or interference from curious or mischievous persons, etc. Nor would it be practical to use one kind of tripping device in the country districts and another in cities and towns. What has been said of tripping devices mounted on the roadbed is in a large measure true concerning arms extending from posts to engage with companion devices on the locomotive, with the difference that they would not be likely to be clogged by packing snow or pieces of ballast, although their operation is liable to be affected by sleet or violent wind storms, as is the case with automatic visual signals. To the signal engineer the question of clearance and train speed offer serious objections, inasmuch as the size and height of locomotives and cars vary to such an extent as to make impossible adjustment for trains running "on single or double" or on the inside tracks of a four-track road, or where the signaling point happens to be opposite a side track or turnout. The utter impracticability of setting posts to carry these arms between the tracks is too apparent to need discussion, as headless engineers would soon become the rule rather than the exception. It seems unnecessary to refer to the carelessness in the manner of loading and staking lumber cars or the difference in the size of freight cars and the danger to brakemen traveling or sitting upon them; notice would also have to be taken of the height and arrangement of ventilation bonnets on passenger cars.

Having noted some of the objections made by practical railroad men to moveable or trigger tripping apparatus, it is in order for us to turn our attention to the locomotive equipment.

It is said to be difficult to "teach an old dog a new trick." All locomotive engineers are not old, but from personal experience the writer believes that there is not a class of men in the world more fixed in their opinions or who take more unkindly to "land-lubbers' " suggestions than locomotive engineers.

Their habits and ideas are the results of the character of their occupation, and when it is realized that the lives and property entrusted to their care, as well as their own lives, largely depend upon the working conditions of the locomotive, it cannot be wondered that they, as well as the managements of the roads, hesitate to adopt anything of an insecure character, or anything that takes the control of the locomotive out of the hands of a competent engineer, or makes him less responsible than at present. He has for years been trained to open and close the steam valve with the "throttle lever," and to set and release the air brakes with the "engineer's valve." Change this method of operating trains and the "old-dog-learning-a-new-trick" adage takes on a new significance, when an engineer is compelled to get down from his engine to reset an accidentally tripped air valve, or becomes engaged in readjusting the "auxiliary steam valve," suggested by the "Scientific American," should it happen that he had forgotten to close the throttle lever before doing so.

In the case of the locomotive engineer only two things should be done, and they should be the only two things which a well-qualified engineer would do when brought face to face with a great danger, namely, cut off the motive power and overcome the momentum in the order mentioned. He can do no more, and should do no less. Those two acts performed, his further presence on the locomotive is unavailable. Should he become rattled and apply the brakes before cutting off steam on a down grade or slippery track he is liable to skid the wheels, and otherwise bring a tremendous strain upon the entire train equipment.

This is what inventors who stop at tripping a brake-valve only would do, at a cost for wheel repair (on a long train) approximating the property damage resulting from an ordinary collison. In the writer's opinion there is no superintendent of motive power worthy the name who would consent to an auxiliary valve in the steam pipe even if it could be placed there and operated without a special opening through the boiler with glands and packing similar to that through which the present throttle stem works. It therefore follows that the cutting off of the steam or motive power must be accomplished by the operation of the present throttle valve, by both the engineer and the automatic device. Such an operation requires considerable effort and should be accomplished by either steam from the boiler, or air pressure from the air-brake system, as any foreign power, such as electricity, would require expensive and complicated apparatus, in the form of batteries or dynamos and magnets, which from the nature of things could not be of a strong or durable character, apparatus that would require for its care engineers well versed in that class of electrical work.

Such apparatus must also be available for operating the air-brake system; we can therefore safely set aside any further consideration of such devices, and return to the consideration of devices operated by air or steam pressure, which can be made exceedingly strong and durable, and can be arranged to close the steam valve, and in the performance of that act automatically reduce the train pipe pressure to a predetermined degree as for example, to the equivalent of the "service" or "emergency" position, as done by the engineer under normal conditions. This accomplished it would remain to provide for a quick and easy restoration of normal running conditions should an accidental action of the apparatus occur.

For the railroad manager or signal engineer to say such apparatus is unobtainable, would be equivalent to saying that human ingenuity had already exhausted itself in the production of the present best forms of visual signals, which of themselves cannot operate to stop a train except they are seen, understood and obeyed. It has been said that automatic train controlling stops would make the engineer careless, because of his dependence upon them. The same has been said of each and every system of visual signals, but with more truth since the beginning of automatic railroad signaling, as a safeguard. The operation of an automatic stop would be known by many, while the passing of a visual danger signal is known to only those who are especially on the lookout for it, except when a collision follows the act. With such apparatus an engineer's mind, like a steam engine, may sometimes get on a dead center, and yet the traveling public be not left to feel that they are depending altogether upon the human sight or the manual element, a fact which should bring home to railroad managers, if not to State legislators or the Interstate Commerce Commission, the duty they owe to the traveling public to prove this statement at the earliest possible moment, as such matters are not questions of convenience or personal opinion to be relegated to oblivion by any off-hand statement of some self-sufficient official.

Humanitarians have offered medals and great rewards for the saving of life at sea; can they, or Congress, do less for the saving of life on land, by encouraging the production of means which might have prevented the loss of "seventy-five lives in fifteen days," as was the case in the second month of 1903.

What is now said of steam train control must soon be said of electrically-operated trains.

F. E. Kinsman, E. E.

91 Liberty St., New York city, April 18, 1903.

Notes and Queries.

E. H. S. asks whether sea water may be safely used in binding macadam. We shall be glad to hear from any of our readers who have used sea water for this purpose. In our issue of Nov. 17, 1892, will be found reports from 15 English seacoast towns where salt water had been used for sprinkling macadam and other pavements. They were unanimous in the belief that salt water hardens and preserves macadam, and that one sprinkling of salt water is often as good as three sprinklings of fresh water.

D. A. D. asks for Wellington's pile formula. The Engineering News formula, originated by the late A. M. Wellington, is doubtless referred to. It is as follows:

$$L = \frac{2wh}{d+1},$$

In which L is the safe load in tons (using a factor of safety of six); w is the weight of the hammer in tons; h is the fall of the hammer in feet; and d is the penetration or "set" of the pile in inches, under the last blow of a free-falling hammer (not retarded by hammer rope) striking a pile having a sound head. If a friction clutch driver is used, so that the hammer is retarted by the rope fastened to it, the penetration of the pile is commonly assumed to be just half what it would have been had no rope been attached, that is free falling. There have been too few experiments made to warrant any great reliance upon this last assumption. Furthermore the engineman by a little sharp practice may so manipulate the friction clutch as to greatly retard the fall of the hammer of a friction clutch driver.

D. K. S. asks:

Is there any coating, other than paint, that will stop the white efflorescence disfiguring the face of a brick wall? In my case the efflorescence appears as a fine powder which is washed off by every rain. But it reappears almost immediately and covers almost the entire surface of the wall. Will a wash of silicate of soda prevent this; and if so, what is the best method of applying it?

Baker, in his "Treatise on Masonry Construction," recommends the use of "Sylvester's washes, consisting of alternate applications of soap and water and alum and water. We shall be glad to hear from any of our readers who can report experience in dealing with efflorescence or with means for preventing its occurrence in the original construction.

SKIPS WILL REPLACE CAGES in the Red Jacket shaft of the Calumet & Hecla copper mine, Michigan. The skips are to have a capacity of nine tons. The old double-deck cages carrying the loaded ore cars give a far greater dead load than do skips, and modern practice in mining on a large scale tends more and more toward the use of skips or buckets, into which the ore is loaded from underground bins.

NOTES FROM THE ENGINEERING SCHOOLS.

IOWA STATE COLLEGE.—Recent non-resident lectures in the Civil Engineering Department have been delivered by Mr. G. M. Davidson, Chemist and Engineer of Tests, of the C. & N. W. Ry., on the subject of "Chemical Purification of Water for Locomotive Boilers," and by Mr. M. O. Eldridge, Assistant Director of the Road Inquiries Bureau, on "The Good Roads Problem."

Demand from employers for graduates of the Engineering Department is very strong, and positions are being offered to the students before graduation. The number of engineering students has increased fourfold within the last six years and now amounts to nearly 600.

The formal dedication of the new Engineering Hall will occur May 22. The principal address will be delivered by Dr. R. H. Thurston, Director of Sibley College, Ithaca, N. Y. Short addresses will also be given by Mr. M. J. Riggs, Manager of the Toledo Branch of the American Bridge Co. of Toledo, Ohio, and by Mr. W. Clyde Jones of Chicago.

BROWN UNIVERSITY.—The following large pieces of apparatus have been ordered for the new engineering laboratory: A Riehle Brothers' testing machine of 400,000 lbs. capacity, built to test tension and compression specimens 10 ft. long or less and cross-bending specimens 20 ft. long or less; one of the special features in the construction of this machine being that the extension arms used in the cross-bending tests will be below the level of the floor and covered with removable floor plates; a Babcock & Wilcox 100-HP. boiler, built for 250 lbs. pressure; a Harris-Corliss cross-compound condensing engine, 10 and 18 ins. × 30 ins. This engine is being built especially for the laboratory and will have double-ported valves and two eccentrics on both cylinders.

A NEW ROTARY CONCRETE MIXER.

The old prejudice against machine-mixed concrete is fast dying out, and with the recognition of the many advantages of such concrete over hand-mixed concrete in point of uniformity, rapidity and cheapness, there has opened up an extensive field for the introduction of concrete mixing machines. A number of such machines have been described in our columns, and one of the latest machines put upon the market is the subject of the present article. It is the invention of Mr. H. Miscampbell, Superintendent of the Clyde Iron Works, of Duluth, by which firm the machine is made, and we are indebted to Mr. C. A. Luster, President of the firm, for plans, photographs and other information.

The machine is of a different character from other concrete mixing machines, consisting essentially of a shallow horizontal revolving pan in which the materials are mixed by stationary plows or blades, the finished concrete being dumped through traps in the bottom of the pan.

A thorough and rapid mixing of the materials is claimed, and one of the special advantages claimed for the machine is that the mixing is done under the eye of the operator, who can see that every batch is of the proper consistency before it is discharged. The machine is built in two sizes, the larger one is stationary, while the smaller one is portable, being mounted on a wagon bed and wheels. Fig. 1 shows one of the smaller machines with the plows raised, in position for charging or dumping. Fig. 2 shows the same machine with the plows lowered into the pan in position for mixing. This machine is operated by a engine or motor of 3 to 4 HP. Each charge or batch makes ½-cu. yd. of concrete, the capacity being 100 cu. yds. of concrete per day of 10 hours The weight of the portable machine is about 2½ tons, including the wagon bed and wheels.

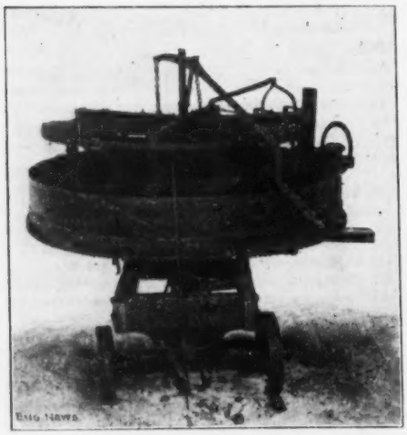

Fig. 1. Position for Loading or Dumping.

Fig. 2. Position for Mixing.

ROTARY CONCRETE MIXING MACHINE.
J. Miscampbell, Inventor; Clyde Iron Works, Duluth, Minn., Builders.

The construction of the machine is shown in further detail in Fig. 3. The pan, A, is annular in form, 8 ft. 8 ins. and 4 ft. 1¼ ins. outside and inside diameter; it is 2 ft. 3½ ins. wide and 12 ins. deep. In the bottom are three openings, fitted with trap doors 10¾ to 14 5-16 ins. wide and 2 ft. 1¼ ins. long, hinged on one of the radial or long sides. The bottom and traps are of 5-16-in. steel plate and the sides are of ¼-in. plate. The pan is supported by a framework of nine radial steel arms with lateral connections, and runs on a ball bearing composed of 1½-in. steel balls in two cast steel circular chases, 2 ft. 10 ins. diameter. The details of this arrangement are shown in Fig. 4 Should the outer rim of the pan drop from any cause, it can be raised and maintained in proper level position by screwing up the nut on the rod A, in Fig. 4. Under the pan is a circular rack, by means of which the pan is revolved, the gearing being driven by belting from an engine or motor. The entire structure is of metal, with the exception of the wagon frame, and all castings are of steel.

Within the pan, but eccentrically located, is a circular frame, B, Fig. 3. To the under side of this are attached 12 plows, C. These are staggered in position across the frame, so as to cover the entire width of the pan, and they are set to throw the materials alternately to the right and left. The circular frame is carried by radial arms, on a central post, and by means of the lever, E, the frame can be raised or lowered as required. Across the pan rests a steel scraper attached to the arm, F, and this scraper may be raised and lowered by the lever, G. The circular plow frame and the scraper are both stationary, the revolving pan carrying the material around. The pan revolves continuously, making about 9 to 11 revolutions per minute.

The operations are as follows: The plow frame being raised, the measured quantity of sand is dumped in at the right, and the scraper is lowered sufficiently to level it off as it is carried round. The cement and stone are similarly dumped and leveled. The plow frame is then lowered, by which time the different ingredients will have been thoroughly mixed. Then the lever H is thrown, raising trips which release or unlatch the trap doors in the bottom of the pan. At the same time the scraper F is dropped to the bottom of the pan by the lever G. As each trap reaches the scraper it opens or drops, discharging the concrete which is held back by the scraper, so that in one revolution the pan is entirely cleared. The tripping mechanism is then again thrown out of gear. After passing the dumping point and getting beyond the scraper, the doors are automatically raised and latched. Wagons, skips, or a conveyor may be placed under the pan to receive the concrete.

The first machine was of special size, having a capacity of 100 cu. yds. per day of 10 hours, and was used in 1901 on the construction of the north pier at the mouth of the Duluth ship canal. Hand mixed concrete was at first employed, but towards the end of the season the machine was introduced in order to expedite the work, owing to scarcity and expense of labor. The following letter explaining the general results of the machine was written to the makers in December, 1901, by Mr. Clarence Coleman, M. Am. Soc. C. E., U. S. Assistant Engineer in charge of the construction of the concrete superstructure of the piers:

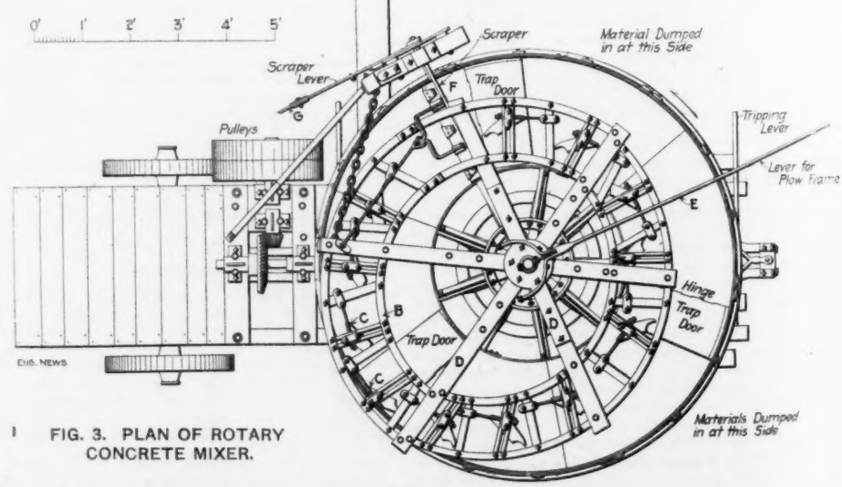

FIG. 3. PLAN OF ROTARY CONCRETE MIXER.

I had an opportunity to see the practical working of your concrete mixing machine in mixing upwards of 400 cu. yds. of concrete at the close of the working season on the north pier of the Duluth ship canal this year. The machine mixes the concrete very thoroughly, cleans itself perfectly at each dump, and possesses the great advantage of mixing the concrete exposed to view during the entire operation in such a manner that the proper amount of water can be estimated and correctly applied. With the materials properly supplied I should judge the capacity of this machine to be about 120 cu. yds. per day of ten hours.

THE UNION ENGINEERING BUILDING IN NEW YORK CITY.

We have been furnished with the following official report of the meeting held on May 7 at the House of the American Society of Civil Engineers in New York city:

On the evening of May 7, in accordance with invitations, the boards of directors of the several bodies interested, as well as some other members of the different societies, held

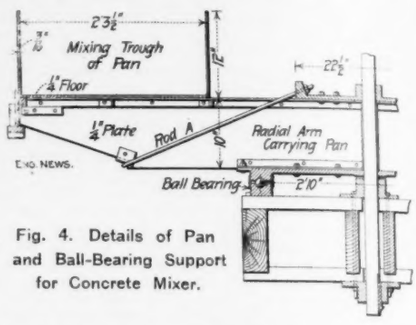

Fig. 4. Details of Pan and Ball-Bearing Support for Concrete Mixer.

an informal meeting at the house of the American Society of Civil Engineers, to consider the gift of $1,000,000 from Mr. Carnegie for a Union engineering building. Sixty-five gentlemen were present, including Presidents Alfred Noble, of the Civil Engineers; Dr. A. R. Ledoux, of the Mining Engineers; J. M. Dodge, of the Mechanical Engineers; C. F. Scott, of the Electrical Engineers, and J. C. Kafer, of the Engineers' Club. The meeting organized with the election of Mr. Noble as chairman, and the appointment of Mr. T. C. Martin as secretary.

A very free, frank and open discussion of the subject, its advantages and its possible objections, was had, lasting about three hours.

The president of the American Society of Mechanical Engineers, Mr. James Mapes Dodge, reported that at a meeting of their Council in the afternoon, the formal resolution* proposed in the letter of W. A. Redding, Esq., May 1, had been adopted, and a committee appointed, comprising Prof. F. R. Hutton, C. Wallace Hunt and himself. This committee is to act first as a conference committee, and is authorized to make such changes in harmony with the spirit of the resolution adopted as may be deemed advisable upon conference with the committees of the other bodies. The same committee is to be retained as a permanent committee.

*The resolution referred to committed the Society in general terms to acceptance of Mr. Carnegie's gift and to united action with the other societies to that end.

The president of the American Institute of Electrical Engineers stated that the board of directors had endorsed the resolution proposed by Mr. Redding, and had appointed a conference committee, comprising Mr. Calvin W. Rice, Mr. T. C. Martin and himself, with instructions to report back a definite form of resolution which should be adopted. He further stated that it was expected by the board that final action would be taken on May 19, as there was a board meeting and also an annual meeting of the Institute on that day.

The president, and the secretary, Dr. Raymond, of the American Institute of Mining Engineers, stated that their institute would have a board meeting on the following day. Both of the gentlemen, however, were in hearty accord with the plan, and said that they considered it not a question of whether they should come in, but of the best ways and means of doing so.*

The American Society of Civil Engineers will probably have a board meeting within the coming week. One of the past-presidents, Mr. Geo. S. Morison, stated that as they already had a building the conditions were different with their society; but after giving the matter careful consideration he was of the opinion, speaking for himself, that the relations which they should sustain to the general engineering interests were such that, leaving aside their own individual preferences, the society should join with the others.

Representatives of the Engineers' Club expressed hearty accord with the general scheme. Mr. Kafer stated that delegates to the conference would be appointed at the meeting of Officers on May 11.†

Resolutions were adopted without a dissenting vote, expressing appreciation and thanks to Mr. Carnegie for the generous offer which he has made, and a cablegram of gratitude to him for his offer, drafted by Mr. Morison, was adopted and sent.

It was agreed that the conference committee, consisting of three representatives from each of the five bodies, should be called to determine upon the next steps and the next action by the several bodies, at the call of Mr. Scott.

Mr. Kafer stated during the evening that Mr. Carnegie had also undertaken to finance the land for the societies and that interest at 4% on the land investment would not be asked by Mr. Carnegie until the building itself was finished. Mr. Carnegie's financial agent, Mr. R. A. Franks, has already paid out for them $50,000 in options on the properties on 39th St., which now represented a buying price of $517,000.

The resolutions adopted were as follows:

I. That those present hereby signify their profound appreciation of the recent action of Mr. Andrew Carnegie in donating to the cause of engineering, and in recognition of the engineering profession, the sum of one million dollars for the erection of a Union Engineering Building; and also for otherwise making it possible to accept and utilize this sum by his liberal, unencumbered and prompt co-operation in financing a suitable site.

II. That it is their firm belief that the result of this initiative will be potent for good, and of far-reaching inclusiveness, greatly increasing the effectiveness of the engineering profession, both technically and socially, and with corresponding benefits to the industrial arts and the world at large.

III. That they hereby tender Mr. Andrew Carnegie their gratitude for his generous offer.

CABLEGRAM.

Andrew Carnegie, Iron and Steel Institute, London.

Members of engineering societies informally assembled send this message of gratitude for your generous offer.

T. C. Martin, Secretary.

OPINIONS OF PROMINENT MEMBERS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS RESPECTING THE UNION ENGINEERING BUILDING.

On May 8 we addressed a circular letter to forty prominent members of the American Society of Civil Engineers, asking from each a brief expression of opinion on the following question:

What action should the American Society of Civil Engineers take with reference to Mr. Carnegie's offer to build a million-dollar Union Engineering Society building in New York city?

The names were selected, it need hardly be said, wholly without knowledge of the position of the parties addressed upon the question, and an attempt was made to cover as broad a field as possible by selecting representative names in different branches of the profession. All the names chosen, however, were those of civil engineers, as that term is generally used, and not of men who while they are members of the Society have their chief interest in mechanical, mining or electrical work.

We print below all the replies received up to the time of going to press:

*At the meeting of the officers of the American Institute of Mining Engineers on Friday, the following gentlemen were selected as conference delegates: Dr. A. R. Ledoux, Charles Kirchhoff and Theo. Dwight.

†Later advices state that the delegates appointed on that date were Mr. Kafer and Messrs. W. H. Fletcher and W. A. Redding.

"Should Most Certainly Co-operate."

In my opinion the American Society of Civil Engineers should most certainly co-operate with the other engineering societies in promptly accepting Mr. Carnegie's exceedingly generous offer of a joint building for the several engineering societies of America.

C. F. Loweth.

Chicago, Ill., May 11, 1903.

Not Prepared to Express an Opinion.

This matter is one of such great importance that I am not prepared to express a definite opinion. Before I should favor the suggestion I should need to have very strong arguments placed before me as to the benefit that the Engineering Society as a whole would derive, and especially as to the benefit to be derived by the American Society of Civil Engineers. Very truly yours,

Wm. Barclay Parsons.

320 Broadway, New York, May 9, 1903.

"Unwise to Neglect the Opportunity."

Replying to your letter of yesterday, I note that, in my opinion, it would be unwise for the American Society of Civil Engineers to neglect the opportunity afforded by Mr. Carnegie's generous offer. A man who has a comfortable house often sells it in order to move to a location where his children may have better educational and social advantages. It seems to me that the civil engineers should do likewise for the sake of the greater advantages which will accrue to their members under the proposed plan. Yours truly,

Mansfield Merriman.

Lehigh University, South Bethlehem, Pa., May 9, 1903.

"Should Co-Operate Heartily with the Other Societies."

My answer to your inquiry is that the American Society of Civil Engineers should co-operate heartily with the other societies in accepting the generous offer of Mr. Carnegie and in erecting a new union headquarters for engineers. I believe such action to be for the interests of the enginering profession as a whole and also for the interests of the American Society of Civil Engineers. I have discussed the matter with a number of Boston engineers who are members of this society, and no one has dissented from the view that Mr. Carnegie's offer should be accepted. Yours very truly,

F. P. Stearns.

1 Ashburton Place, Boston, Mass., May 11, 1903.

"We Should Be Generously Glad to Take Part in This Beneficent Trust."

I think there is only one thing to do and that is for us to accept Mr. Carnegie's generous offer with thanks. We are already well housed, but the proposed arrangement would be much better and our financial standing much improved. The other societies have more to gain than we have, and this should call for careful allotment of the share of the burden and benefits in proportion to the interests involved. We cannot, however, draw the line too finely, and because the other societies will benefit more than ourselves is not reason enough to decline. On the contrary, we should be generously glad to take part in this beneficent "trust," especially as the identity and prestige of our Society is preserved. Very truly yours,

A. W. Robinson.

Consulting Engineer, Department of Public Works of Canada, 14 Phillips Sq., Montreal, Canada, May 9, 1903.

"Would Be Distinctly Advantageous to the Society."

From the published information on the subject it appears to me that the acceptance of the offer of Mr. Carnegie would be distinctly advantageous to the American Society of Civil Engineers by affording a more central site and enlarged accommodations under conditions which would enable the expense of the maintenance of its present building to be applied to broadening the functions of the Society.

The co-occupancy of the proposed building under the general administration of a board of trustees on which all of the societies would be represented, does not appear to be an impairment of the individuality of any society which would share in its accommodations.

It is probable that all of the real estate owned by the several societies could be sold at an increase over its first cost. Yours very truly,

C. J. H. Woodbury.

Boston, Mass., May 9, 1903.

"The Society Is Big Enough to Join Hands with Fellow Societies."

I am unable to conceive of a reasonable negative action by the American Society of Civil Engineers in considering Mr. Carnegie's offer. Here seems to me to be an opportunity such as many engineers have longed for to concentrate engineering societies in one building where that mutuality of interests which should exist among all engineers will have an opportunity to aid each organization and each individual in advancing knowledge of the profession and in placing the American engineer to the front among nations. The engineer is but mediocre if he does not advance with the spirit of the times, and this is an advance idea. I trust that the members of the American Society of Civil Engineers will realize that the Society is big enough to join hands with fellow societies and still stand as a leader in engineering science.

Yours truly, W. L. Saunders.

Havemeyer Building, 26 Cortlandt St., New York, May 9, 1903.

"Of Great Value to the Engineering Profession."

Every progressive engineer must view with favor the construction of the single building in which the engineering societies would be housed. I suppose that there will be some difficulties in carrying out this plan and it is barely possible that some few people will not find the new arrangement sufficiently exclusive, thinking possibly there is more dignity to their own particular selves in being apart from everybody else. There may be other more important difficulties in the way of accomplishing the end, but I should suppose that any engineer who is accustomed to considering both sides of a problem, would find some way of getting rid of objections to accomplish a desired end. It seems to me that a common meeting place in New York where one could go to find friends, or even a common library, would be of great value to the engineering profession. As a member both of the American Society of Civil Engineers and of the American Institute of Mining Engineers, and as a former member of the Mechanical Engineers, I think I may view this question without thinking of the special interests of any one society. Yours truly,

H. H. Campbell.

Steelton, Pa., May 11, 1903.

"Heartily in Favor of Its Acceptance."

Coming, as it has, without solicitation or restriction, any question of the propriety of accepting Mr. Carnegie's munificent offer seems to be eliminated. As to the benefits to be derived by the societies, I feel sure they would be positive and real, and I am therefore heartily in favor of its acceptance.

Regarding the plan of operation, I approve that by which members of all engineering societies may, under suitable restrictions and conditions, find in it a home, as appears to have been Mr. Carnegie's intent; although the control should always be with the great National Societies and the Engineers' Club. It would not, in my opinion, be wise to throw open the doors too indiscriminately to the allied professions. The house should always remain, as proposed, for the use of engineers.

I have always favored a closer affiliation between local societies so that, while retaining their independent and local character, provision might be made for the joint publication of papers and for an easy transfer of membership on change of residence. The headquarters of such an affiliation might very properly be in the new quarters.

Yours truly, Kenneth Allen.

Atlantic City, N. J., May 11, 1903.

"All the Specialists in Engineering Could Well Be Housed Under One Roof."

In my opinion the engineers of America should be very grateful to Mr. Carnegie for his munificent offer and they should be able to plan the affairs of their various societies so that they can take advantage of this offer without burdening these societies to any appreciable extent beyond present responsibilities.

The American Society of Civil Engineers ought to appoint a committee with full power to co-operate with the other engineering societies to reduce this question to practical application. Undoubtedly there are advantages and disadvantages, but I firmly believe that a full consideration would show that the former outweigh the latter.

From appearances I should judge that ten years cannot elapse before the American Society of Civil Engineers will have entirely outgrown its present quarters and be forced either to sell out and rebuild on a larger scale elsewhere, or take advantage of present location and expend considerable money in some direction for enlargement of present quarters. Instead of further separation of the various engineering societies it would be a grand culmination to have all of the specialists on engineering be considered Civil Engineers engaged in various branches of the profession, and on this basis they could well all be housed under one roof. Yours very truly,

Geo. B. Francis, Civil Engineer.

10 Bridge St., New York, May 9, 1903.

"Let the Good of the Majority and the Future of the Profession Predominate."

In my opinion it would be a mistake for the American Society of Civil Engineers not to accept the offer made by Mr. Carnegie. The various branches of the engineering

profession are so closely related and interwoven that a joint library and one that would be in reality an up-to-date working library would be a great boon for the profession, in place of the comparatively small and one-sided library that one society could present to its members. Further, such action would bring about a much desired esprit-de-corps among all classes of engineers, and hence a much better general standing in the community at large, and such results would by reflex action tend to broaden the individual.

I trust that all members of the Society who favor the acceptance will be called together or form a strong committee to work for such acceptance by adopting and sending out to the members scattered throughout the country circulars presenting the advantages to be derived by the profession from this step, as I presume there will be quite a large number of local members who will view the question from a narrow and individual point of view. That there are many questions to consider and settle is undoubtedly true, but these can all be satisfactorily adjusted if approached in a broad-minded way and with the determination to let the good of the majority and the future of the profession predominate over self-interest, possible loss of prestige of individual managers, curtailment of the present administrative working force, or the narrow view that a strong society well established in its own quarters should not forfeit anything to help other less fortunately situated allied professional societies.

Walter G. Berg.

261 West 52d St., New York City, May 10, 1903.

"Heartily in Favor of the General Project."

In reply to your inquiry of the 8th inst. I would say, thank Mr. Carnegie and give the matter careful consideration.

I am heartily in favor of the general project of a closer association of the engineering societies if it is practicable, but I cannot express too strongly my objections to the apparent efforts to "railroad" the present project through, or, as Mr. Scott has expressed it, "Endorse the general scheme and look into the objections afterwards. They will appear soon enough." This may be enthusiasm, but it is not engineering.

If it is a question of either following the band wagon or of stopping the band, I say, stop the band!

For the past two weeks the daily papers appear to have been industriously fed, editorials inspired, the property already selected and practically purchased and at a meeting called in the house of the American Society of Civil Engineers, giving color of endorsement by that Society, resolutions and messages were offered favoring the scheme and pledging ourselves to its advancement. It was only then that the members of the American Society of Civil Engineers, who happened to be informally present, awakened to the responsibility they were asked to assume, and it was through their outspoken objection that the message and resolutions were finally modified.

The experience thus gained does not demonstrate the advisability of placing the management of any of the Society's affairs in committees composed of outside interests.

A similar objection has already been raised by members of the Engineers' Club. Very truly,

Henry B. Seaman.

40 Wall St., New York, May 11, 1903.

Wants an "American Institute of Engineers."

I have given the question propounded in your letter of May 8 a great deal of thought. By wise and conservative management the American Society of Civil Engineers has won its place at the head of the national engineering societies of America. The requirements for membership are much higher than those of any of the other societies and it is the only one of any considerable wealth. It has less to gain and more to lose than any of the others by association in any project which may, in the future hamper its management. Its history has been one of progress. No limit should be set to its possibilities of growth in the future. If to-day its house is not large enough, it can easily build one twice as large. Who doubts that in twenty-five years it could, if necessary, build another much larger. It would indeed be pitiful if the thought of getting part of a building for nothing should have any effect in deciding the future of such a great organization.

On the other hand, it represents one branch of a great profession. Alas! that its wise managers in the past should not have been wiser, so that one great American Institute of Engineers might to-day accept with thankfulness the generous offer of Mr. Carnegie. Would the association of these societies in one building ever result in the formation of a great Institute of Engineers of high grade? If such were to be the result, few members of the American Society of Civil Engineers would, I think, object to the project.

I do not believe that it would. The great difference in the character and management of the societies and the fact that each one has already attained large membership would, I think, prevent amalgamation. It would indeed be more convenient, in some respects, to have these four organizations under one roof, and some benefit to the profession at large would doubtless result. It must be remembered, however, that, no matter how large the building, the quarters of any of the organizations might and, if the organization had a healthy growth, certainly would, in the course of time, be too small. And the probability of jealousy and bickering among the managements must not be forgotten. After carefully considering this proposition for many days, I have come to believe that it would be a mistake for the American Society of Civil Engineers to entangle itself in the uncertainties of such a combination.

I have not considered the Engineers' Club in this connection, since the relation of a social organization to the profession is entirely different from that of an engineering society. It is possible that the formation of an American Institute of Engineers, to include members of all branches of civil and military engineering, and which would be of immense importance to the profession, might be delayed rather than hastened by the collection of the societies in one building.

Palmer C. Ricketts.

Troy, N. Y., May 9, 1903.

"The Society Should Make Some Sacrifice to Join Its Sister Societies in so Grand a Scheme."

As a general proposition I am in favor of the American Society of Civil Engineers going into the scheme. But I do not care to express a final opinion until the project is put into definite shape and its details are known. Until this is done it is impossible to decide whether the move will be advantageous or otherwise to the Society. If not positively and seriously disadvantageous, the Society should make some sacrifice to join its sister societies in so grand a scheme.

Without going into details, it may be said that existing conditions not only make the question of entering into the project a difficult one to decide, but they seem to dictate a conservative policy in the matter.

If your inquiry covers the suggestion of plans of organization and management, my personal ideas are as follows:

1st. It seems not only desirable but necessary that the joint interests of the four engineering societies as a whole and those of the Engineers' Club should be organized and maintained separate and distinct from each other, both legally and actually. This need not prevent any advantageous working arrangements between the joint societies, or any one of them, and the Club.

An equitable division of the building fund should be made between the joint societies and the Club, and the amount allotted to each party should be expended under its untrammelled control, and each should be responsible for the management of its part of the fund.

2d. In any arrangement that may be agreed upon between the four societies, for the expenditure of the funds and the future control of the property, both land and building, the rights and the responsibilities of each should be clearly defined. Each society should assume a definite responsibility in meeting the fixed charges (rent, general maintenance, special assessments, etc.) and each should alone be liable for discharging its own obligations. In other words, if any one of the societies should go out of existence or, for any reason, default, the remaining societies should not thereby become responsible for the discharge of its obligations. I regard this as very important.

3d. The division of interest and responsibility need not be equal between the societies. Such division may be based upon the floor space to be occupied or upon any other equitable basis.

4th. The individuality and independence of each society should be maintained and its property, including its library, should continue under its separate and entire control.

5th. In the case of such part of the property as shall be used in common by the societies, as, for instance, the auditorium, a schedule of charges for use should be agreed upon and the resulting fund should be divided between the societies in the ratio of the interest each assumes in the property.

6th. The joint control of the property should be in the hands of a Board of Trustees, in which each society should be represented in the ratio of its interest in the property.

S. Whinery.

Room 910, 95-97 Liberty Street, New York, May 9, 1903.

"Union Would Achieve That Public Recognition to Which the Engineering Profession Is Entitled."

As to the action which this Society should take with reference to Mr. Carnegie's generous offer, I shall briefly state my opinion as follows:

We may consider the question from two aspects: Do we need the donation, and would the united action of the societies mentioned be practicable?

It has just been said in public that we "do not need that help, and it is a little short of degrading to accept it." I do not take this view of the matter. Our engineering societies are not established as private business undertakings for profit and loss, but for "the advancement of engineering knowledge and practice and the maintenance of a high professional standard among its members." In this respect there is no difference between ourselves and the highest colleges of education and learning. Surely no one thinks it "a little short of degrading" for our universities to accept such donations, and has not the standing and efficiency of the colleges been greatly raised, in many cases even made possible, by just such donations? The professional engineer is not yet especially well able to stand the expense of carrying the financial load necessitated by a central office, a library and home, appropriately appointed and consistent with the desired standing of his profession. The American Society of Civil Engineers has not been averse to the acceptance of pecuniary assistance; witness the list of contributors to its building fund and to its library, and the class of membership called "Fellows" who "shall be contributors to the permanent funds of the Society, though they may not be eligible for admission as corporate members." A financial offer which in any way would help the attainment of a higher professional standard, by increasing the facilities for individual intercourse and exchange of learning and experience, therefore, appears to me to be of service to our Society, as well as consistent with its constitution.

The second aspect under which the proffered donation may be considered is the question whether the union of the named societies would be a practicable and enduring one. The answer to this, it appears to me, will depend entirely upon the articles of constitution of this union, as I do not think there is a fundamental difficulty in obtaining a harmonious co-operation of the members of the several branches of engineering. Our own Society acknowledges this fact by stating that "A member shall be a Civil, Military, Naval, Mining, Mechanical, Electrical or other professional Engineer, an Architect or Marine Architect." All engineers have a large common basis of scientific knowledge and experience. Their works interlock and are at times so closely allied that they become even useless without each other.

The answer to the above subject, therefore, seems to depend solely upon the details of organization which shall unite the several societies under a single roof, and this appears to be a purely business proposition rather than a professional matter. It would be necessary, first of all, to guard the present rights and standing of all members and the properties of the respective societies, and then to allow each one of them full freedom of action and development that would not curtail an equal freedom for any of the other societies. It would also be necessary to have a thoroughly representative board of managers, governing all the common interests relating both to the affairs of the proposed building and to the standing and representation of the entire engineering profession.

These conditions seem to me to be entirely practicable and consistent with a permanent union. Perhaps, if the business end of the proposition can be properly solved—and I see no insurmountable difficulty in this—such a union could furnish, I think, sooner than the single societies, the necessary strength to lift the profession to that elevation and to achieve for it permanently that public recognition which has been not only a latent desire for many years, but to which it is entitled, from the work already accomplished in advancing the industrial progress of our country.

Rudolph Hering.

170 Broadway, New York, May 11, 1903.

THE ORGANIZATION OF MANUFACTURING INDUSTRIES.*

Looking over the list of your presidents, their successor is struck by the value of the service they have rendered. Great names are there, among them the chief inventors and pioneers in iron and steel—Bessemer, Siemens, Bell and others, whose names are household words. There is scarcely one who has filled the office who has not been able in his inaugural address to deal with a branch of the subject as perhaps the recognized first living authority upon it. Several have announced and described in your proceedings their own inventions which made them famous. What a contrast the present occupant presents, who has no shadow of claim to rank either as inventor, chemist, investigator or mechanician. None know so well as you, fellow members, that his attention has been centered upon the business department, and that it is experience in this alone which entitles him to address you. I invite your attention this morning, therefore, to the important question of the organization and management of that most complicated of all pieces of machinery—man—which has been my province.

Speaking from experience, we had not gone very far in manufacturing before discovering that perfect management in every department was needed, and that this depended upon the men in charge. Thus began the practice of in-

*Extracts from the Presidential Address of Andrew Carnegie at the Annual Meeting of the Iron & Steel Institute.

teresting the young geniuses around us, as they proved their ability to achieve unusual results—the source of big dividends. These received small percentages in the firm, which were credited to them at the actual cash invested, no charge being made for good will. Upon this they were charged interest, and the surplus earned each year beyond this was credited to their account. By the terms of the agreement three-quarters of their colleagues had the right to cancel it, paying the party the sum then to his credit. This provision was meant to meet possible extreme cases of incompatibility of temper, or if the recipient should prove incapable of development, or of enduring prosperity. At death the interest reverted to the firm at its book value. The young men were not permitted to assume any financial obligation, and not until their share was fully paid by the profits, and there was no further liability upon it, was it transferred to them. Thus thoughts of possible loss never prevented concentration upon their daily duties. They were not absorbed in the daily quotations, for the shares were not upon the stock exchange or transferable. This policy resulted in making some forty odd young partners, a number which was increased at the beginning of each year.

We did not fail to see, as the works enlarged, how much success depended upon the mechanical men, the superintendents and foremen, yet not one of these had up to that time been admitted as partner. The business and the mechanical men—office and mill—were still widely separated. Well do I remember the first attempt to bring these two departments into closer relations. It was made with our Captain Jones, one of your members, well known and appreciated by many of you as in the foremost rank of managers, perhaps the foremost of his day in America. He came to us as a working mechanic at 8 shillings per day. I explained to the Captain how several of the younger men in the business department had been made partners and were actually receiving much greater rewards than he, while his services were at least equally valuable, and informed him that we wished to make him a partner. I shall never forget his reply. "Mr. Carnegie, I am much obliged, but I know nothing about business and never wish to be troubled with it—I have plenty to trouble me here in these works. Leave me as I am and just give me a thundering salary." "Hereafter," I said, "the salary of the President of the United States is yours, Captain," and so it remained till the sad day of his death. My seniors, the presidents of the other manufacturing concerns, did not fail to take me to task for ruining the steel business by paying a mechanic more salary than any of them received. Being much the youngest of these great dignitaries, I humbly confessed my wrongdoing, not, however, failing to inquire if they knew where we could find two or three more Captain Joneses at double the price. We did not overpay the Captain; he was worth several ordinary salaried presidents. The Captain's declination of partnership was the only one which ever came within my experience. None of the other mechanics ever preferred salary to partnership, and they were wise. Nothing can compare with that form. Let me impress that upon the younger members here who may soon have, or should have some day, the choice laid before them. From that time forward the union of the mechanical and business partners went steadily forward until no manager of a mill was without his interest in the business, as pertaining to the position, and no board of management, or important committee, was without a mechanical representative. Thereafter mill and office conferred upon all important sales or contracts. The mechanic and the man of affairs were in constant consultation and fellow partners—one of the most profitable changes that ever we made.

There was another step taken in the same direction. Men having others under their charge were given an interest in the proceeds, or savings in cost, in their department. Where it was impossible to decide the limits of a department, the managers were rewarded by handsome bonuses beyond their salary, based upon the general profits of the year. Thus, as a rule, every man in authority became more than a mere wage earner. He felt himself on the first step of the ladder which led to partnership sooner or later, and was worth any two mere employees paid only a daily or monthly wage and denied special recognition.

This plan of reward according to results for heads of departments has already become so general and is spreading so fast we may be sure it has proved its efficiency. There are few large department stores or important houses in retail trade which have not been forced to adopt it.

This plan is probably bound to prevail to greater or less degree in manufacturing concerns, and the sooner the better, for the greater number of the workers capital can compensate, and in one sense reward, by sharing its gains, the more harmonious and therefore more profitable for both must the relationship become.

The great secret of success in business of all kinds, and especially in manufacturing, where a small saving in each process means fortune, is a liberal division of profits among the men who help to make them, and the wider distribution the better. There lie latent unsuspected powers in willing men around us which only need appreciation and development to produce surprising results. Money rewards alone will not, however, insure these, for to the most sensitive and ambitious natures there must be the note of sympathy, appreciation, friendship. Genius is sensitive in all its forms, and it is unusual, not ordinary, ability that tells even in practical affairs. You must capture and keep the heart of the original and supremely able man before his brain can do its best. Indeed this law has no limits. Even the mere laborer becomes more efficient as regard for his employer grows. Hand service or head service, it is heart service that counts.

One of the chief sources of whatever success may have attended the Carnegie Steel Co. was undoubtedly their policy of making numerous partners from among the ablest of their men, and interesting so many others of ability in results. I strongly recommend this plan to the members of the Institute engaged in business, believing that in these days of threatened exhausting competition it will be the concerns which adopt this plan, other things being equal, which will survive and flourish.

In no field is the wise saying more amply verified than in manufacturing: "There be those who gather, yet scatter abroad, and there be those who scatter abroad, yet put into barns."

If the managing owners and officials of great corporations could only be known to their men and, equally important, their men known to their employers, and the hearts of each exposed to the other, as well as their difficulties, we should have in that troublesome field such harmony as delights us in the field of domestic employment. It is mainly the ignorance of contending parties of each other's virtues that breeds quarrels everywhere throughout the world, between individuals, between corporations and their men—and between nations. "We only hate those we do not know" is a sound maxim which we do well ever to bear in mind.

In the progress toward more harmonious conditions between employer and employed we see that the system of payment by fixed wage has been largely supplanted by payment according to value of service rendered by workmen in positions of authority over others, and by recognition not only in money, but in position, which often counts quite as much as coin, and not seldom much more with the ablest. There remains still receiving the fixed wage the great mass of ordinary workmen; but we see in the history of the relation of employer and employed that these have not failed to rise greatly also. The movement tending to improve the position of the worker has not passed over even the humblest, but has reached and benefited all.

To-day we have reached the stage of perfect equality between the two contracting parties. Each is free to demand terms or to terminate agreements. Labor is worthy of its hire and is now paid this in coin, the law in many lands going so far as to make its claim a first charge upon the employer's property—a great advance. But the irresistible pressure which has forced change after change in the relations of capital and labor still operates unchecked—a sure indication that the final stage has not yet been reached. We have evidence of this in another important advance, the sliding scale, which provides not a fixed wage but in some degree settles by results. Increased demands bring higher prices and profits to the employer, which in turn bring workmen higher returns, so that as the employer's profits rise and fall, so do the workman's rewards. If I were asked what was the best service the Carnegie Company were ever able to render the wage earner, next to giving steady employment of wages equal to any, I should answer, by persuading them to adopt the sliding scale, with a minimum insuring living wages, at their works at Braddock 14 years ago, which has given perfect satisfaction from that day to this and is still in force, and has produced undisturbed harmony between capital and labor. The sliding scale is a great advance over the fixed wage, not only by securing the workman a prompter and more certain share of the profits, but also because it raises his status. He is something akin to a proprietor when he shares varying profits instead of having merely a fixed wage. He has risen in the scale and is more of a man, and the more of a man the better and more valuable the workman.

Gentlemen, while, as you have seen, the Carnegie Steel Company interested their young men as partners and were always anxious to reward exceptional service, and carried the bonus system to an extent, perhaps, unknown in any similar organization, the masses of the ordinary workmen could not be embraced under the limited partnership form, even if it had been thought desirable that their savings should be so invested. The objection to this from the point of view of the workman, which always arose in our minds and which we were never able to surmount, was the sad and instructive history of the largest manufacturing concerns, especially those of iron and steel.

More than once in the history of the Carnegie Steel Company leading partners have been so doubtful of their future as to beg their more optimistic senior partner to buy large amounts of their interests at actual cost.

It is an instructive fact that the majority of the principal of these in the United States have, at some period in their career, either been in the hands of receivers, been mortgaged, reorganized, or sold by the sheriff to the great loss of their original owners. Indeed, those who have escaped financial trouble are the exceptions. The great Cambria Iron Co. were twice in trouble and once sold by the sheriff; Joliet Works were also so sold; the Bethlehem Co. have twice been mortgaged; the 6% first mortgage bonds of the immense Chicago Works have sold for as low as 70%, and their shares at less than one-half of their par value. The Troy Iron & Steel Co. have lost heavily and undergone several reorganizations. It may be said that these disasters are of the distant past, but history has a way of repeating the past which we do well to remember. The Pennsylvania Steel Co. have in recent years been in the receiver's hands. Their shares in demand at $300 in 1881, sold in '93 at low as $20. There was no overcapitalization in any of these companies. Only actual cash counted. Even to-day, as I write, we hear of the Consolidated Lake Superior Co. being embarrassed—after investing of cash capital $34,000,000. Their preferred shares, which recently sold for $80 per share, are to-day quoted on the exchange at $15.50. The common stock, last year at $30 per share, sells to-day for $4. It is just announced that our oldest and largest shipbuilding company must be reorganized, for which $7,500,000 are needed. Their shares, which have sold above $85, are now at $38. The vicissitudes of the leading iron and steel concerns of Tennessee and Colorado are still in evidence. Our friends in Canada have similar experiences. Shares of their large Dominion Iron & Steel Co., which sold at $60 last month, are quoted to-day at $25.

Our experience in America has not been peculiar. The year before last the iron and steel works of Germany were generally in depressed condition, and their shares suffered heavily. I read a list of these losses at the time which impressed deeply. If I remember rightly, many declined one-half or more. Several important works were reported in financial trouble. Your own experience in Britain is similar. Not a few concerns, after vibrating between seasons of loss and gain, have from time to time had to be reorganized, entailing heavy losses upon shareholders. Uncertainty of results pertains not only to iron and steel, but to all forms of business operations, and is inherent in them.

Had the employees of leading American railway systems invested in their shares last year they would already have lost nearly a quarter of their savings, Pennsylvania Railroad shares having fallen $38; New York Central, $40; Chicago, Milwaukee & St. Paul, $41; Illinois Central, $42. It may be said these losses may be recovered. Quite true, but also true they may be doubled. No man can tell.

You know too well, gentlemen, how the path of iron and steel is strewn with financial loss in all countries, and that all forms of business must encounter grave risks. Scarcely a week passes without news of embarrassment or failure in the industrial world. Thus it has ever been, and ever must be, while human nature remains unchanged.

Bearing all this in mind, the thought of asking the workingman to risk his precious savings in the manufacturing or any form of business way always discarded by us as too dangerous for him. He was advised to buy a home instead and save his rent. To facilitate this, money to build a home was lent to any of the employees who had the ground clear of debt. Their savings up to $2,000 each were taken by the company and placed in a special trust fund, entirely separate from the business. Interest at 6% was allowed, to encourage the workman to save part of his earnings for old age. The funds received were lent upon mortgage on real property, generally to such workmen as wished to build homes. It was believed that this was the safest, and therefore the wisest, use of their savings which workmen could make.

The most convincing proof of the steady march of labor to recompense more and more based upon profits, and in forms drawing capital and labor into the peaceful bonds of mutuality, is to be credited to the United States Steel Corporation, the largest of all industrial corporations, and for which they deserve unstinted praise, as proving a genuine interest in the workmen and sagacious thought for their own.

It is in this form: 25,000 of the $100 shares of preferred 7% stock were offered to their 168,000 employees at $82.50 per $100 share, in different amounts according to their earnings, which were subscribed for twice over; nearly one-sixth of the men subscribed—one-half being salaried men. Twenty thousand more shares of stock were afterward provided, making 45,000 in all, worth about $4,500,000. Monthly payments are received. Another distribution of shares is intended next year.

It will be noted that the investment is at the risk of the men. This seems a feature which we may, however, expect the corporation to change as experience is gained, as the plan is most wisely stated to be subject to future changes. In most of the States of the Union labor's precious earnings, surely the most precious of all capital, are a first charge upon property, and this I believe the only safe policy to follow. "Every workman a shareholder" would end most of the conflicts which sadden us between capital and labor. To effect this every corporation could well afford to offer to distribute part of their shares among the saving workmen, and, in case of disaster, give preference to repayment of principal as a first charge. Any desired legislation with proper safeguards could be readily obtained authorizing corporations to make savings of employees up to a certain sum for each a preferred claim, ranking before mortgage or ordinary debts or the claims

of shareholders, akin to the Mechanics' Lien and the Homestead exemption laws. This seems due to the workingman, who, necessarily unacquainted with business, takes his shares upon trust and becomes the beneficiary or the victim of his employers. He should be considered as an inexperienced youth in the affair; besides, he is asked to invest not solely for his own, but at least equally for the advantage of his employer.

Thus we see, gentlemen, that the world moves on step by step toward better conditions. Just as the mechanical world has changed and improved, so has advanced the world of labor from the slavery of the laborer to the day of his absolute independence, and now to this day when he begins to take his proper place as the capitalist partner of his employer. We may look forward with hope to the day when it shall be the rule that the workman is partner with capital, the man of affairs giving his business experience, the workingman in the mill giving his mechanical skill to the company, both owners in the shares and so far equally interested in the success of their joint efforts, each indispensable, without whose co-operation success were impossible. It is a splendid vista along which we are permitted to gaze.

Perhaps I may be considered much too sanguine in this forecast, which no doubt will take time to realize, but as the result of my experience I am convinced that the huge combination, and even the moderate corporations, have no chance in competition with the partnership which embraces the principal officials and has adopted the system of payment by bonus or reward throughout its works. The latter may be relied upon as a rule to earn handsome dividends in times of depression, during which the former, conducted upon the old plan, will incur actual loss and perhaps land in financial embarrassment. In speaking of corporations we must not forget, however, that there are many who are corporations in name only, their management being the life work of their few owners. These rank with partnerships, having all the advantages of this form. The true corporation is that whose shares are upon the Stock Exchange and whose real owners change constantly and are often unknown even to the president and directors, while to the workmen they are mere abstractions. It is impossible to infuse through their ranks the sentiment of personal regard and loyalty in all its wonderful power.

The idea of making every workman a capitalist and of sharing large percentages of the profits among those rendering exceptional service will probably encounter the opposition of the extremists on both sides, the violent revolutionist of capitalistic conditions, and the narrow grasping employer whose creed is to purchase his labor as he does his materials, paying the price agreed upon and there an end. But this opposition will, we believe, amount to little. It will even speak well for the new idea if it be scouted by the extremists and commended by the mass of men who are on neither dangerous edge, but in the middle, where usually lies wisdom.

Meanwhile, here is the germ of a promising plan offered as a solvent for one of the pressing problems of our age, which may prove capable of development. As members of the Institute let us receive, study and discuss it with open mind. That the problem will be solved, and that the two allies are some day to live in friendly co-operation, let no one doubt. Human society bears a charmed life. It is immortal and was born with the inherent power or instinct, as a law of its being, to solve all problems finally in the best form, and among these none more surely than that vexed question of our day, the relations between these Siamese Twins, which must mutually prosper or mutually decay—capital and labor.

REPORT ON BAD FOUNDATIONS BENEATH THE CORE-WALL OF THE EARTH PORTION OF THE NEW CROTON DAM.

The disintegration of the limestone foundations beneath the core-wall of the earth section of the New Croton Dam has been made the subject of a report by Mr. Wm. R. Hill, M. Am. Soc. C. E., Chief Engineer of the Croton Aqueduct Commission. In our issue of Nov. 28, 1902, we published a report on proposed changes in the earth portion of the dam, made by a commission of engineers. The commission endorsed a recommendation by Mr. Hill to the effect that the masonry portion of the dam be extended further to the south, thus replacing the earth and masonry core-wall portion of the original design. Since that date work has been in progress on the removal of the earth embankment and core-wall, and an excavation has been carried to some distance below the original foundation. Fig. 1 shows the original design for the earth portion of the dam and its junction with the masonry portion (the plan is reproduced from our issue of Nov. 28, 1902). Figs. 2 and 3 show the results of the removal of the embankment, and a portion of the excavation beneath the core-wall. Fig. 4 is a recent general view of the masonry portion of the dam.

Mr. Hill's latest report on the subject, dated May 8, is as follows:

To the Aqueduct Commissioners. Gentlemen: On March 30 of this year, I called to your attention the character of the natural foundation disclosed as underlying the core-wall at the south end of the New Croton Dam, which is in process of removal, prior to the substitution therefor

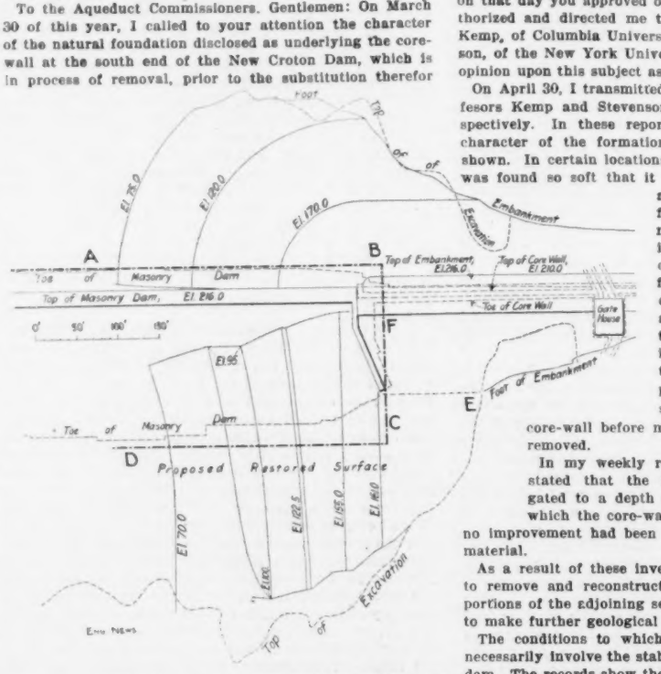

FIG. 1. ORIGINAL PLAN OF SOUTH END OF NEW CROTON DAM, SHOWING EARTH EMBANKMENT AND JUNCTION OF SAME WITH MASONRY STRUCTURE.

of the solid masonry construction recommended by me shortly after my appointment as chief engineer. In that report I stated that the natural limestone foundation was more or less disintegrated and gave every evidence of being in the process of further disintegration and that the softer portion would quickly absorb water and could be easily and completely crushed in the hand to the form of sand.

On April 3 I stated that after receiving an official report from the division engineer on the subject I would recommend that the services of competent geologists be obtained to make a report upon the character and probable extent of any soluble and shattered material found under the core-wall, gate-house and in the foundation pit, and also upon the character of the rock upon which the said extended masonry dam will be founded. At your meeting on that day you approved of my recommendation and authorized and directed me to invite Prof. James Furman Kemp, of Columbia University, and Prof. John J. Stevenson, of the New York University, Geologists, to give their opinion upon this subject as suggested.

On April 30, I transmitted to you two reports from Professors Kemp and Stevenson, dated April 16 and 30, respectively. In these reports the insecure and unstable character of the formation underlying the core-wall is shown. In certain locations it is stated that the material was found so soft that it "runs with water like sand," and that it is uncertain how far down the disintegration may have penetrated, depending largely upon geological conditions in the past. They find the condition of the foundation of Gate-House No. 1 and the adjoining portions of the Old Aqueduct as "deserving very serious consideration." These last mentioned portions of the structure are south of and adjoining the core-wall before mentioned, which is now partly removed.

In my weekly report to you, dated May 5, I stated that the foundation had been investigated to a depth of 45 ft. below the base upon which the core-wall stood and that at that depth no improvement had been shown in the character of the material.

As a result of these investigations it may be necessary to remove and reconstruct Gate-House No. 1 and small portions of the adjoining sections of the Old Aqueduct and to make further geological and engineering examinations.

The conditions to which I call your attention do not necessarily involve the stability of the main portion of the dam. The records show the existence of two narrow seams of softer material than the surrounding rock which were examined and treated before its construction was begun. There may be leakage under the masonry, but there is no evidence of it and the investigation suggested will set at rest any doubts on this point.

In view of these facts, and considering the importance of the engineering work involved, I recommend that the Aqueduct Commissioners appoint a consulting expert engineer to advise with me in such investigations and upon all future questions arising in the construction of the New Croton Dam. Yours respectfully,

May 8, 1903.

W. R. Hill, Chief Engineer.

(Note by Mr. Hill.)

The Aqueduct Commissioners to-day appointed Prof. William H. Burr, of Columbia University, expert engineer to advise the commissioners and consult with their chief engineer on the whole subject involved in the report.

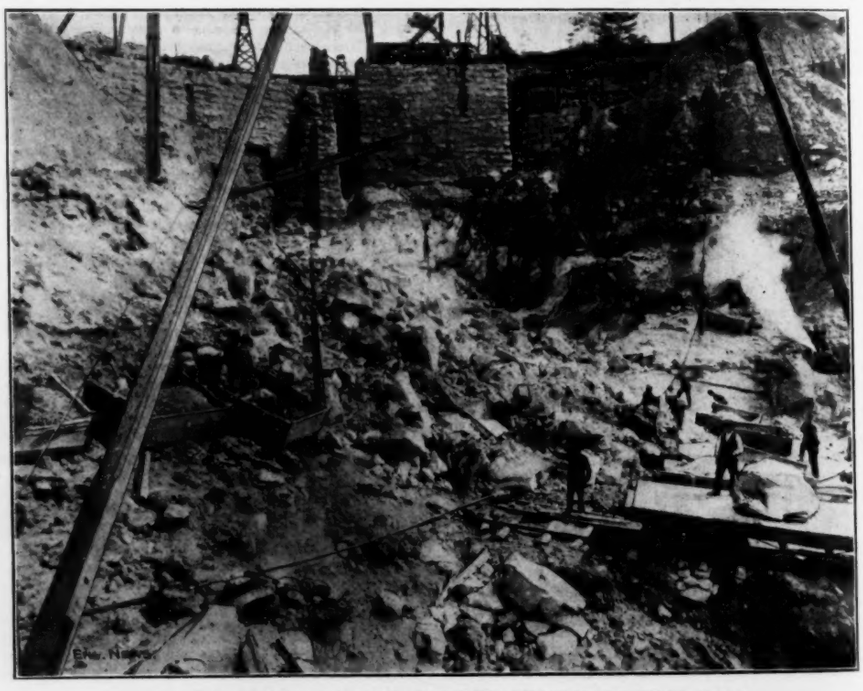

FIG. 2. EXCAVATING ROCK BENEATH FOUNDATION OF CORE WALL.
(Looking South; Gate-House No. 1, Exposed to Foundation in Back Center and Wall Protecting Old Aqueduct at Left.)

ADDITIONAL LETTERS REGARDING THE ACTION OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS TOWARD THE UNION ENGINEERING SOCIETY BUILDING.

After pages 435 and 436 went to press we received the following additional replies by mail and telegraph to our circular letter of May 8:

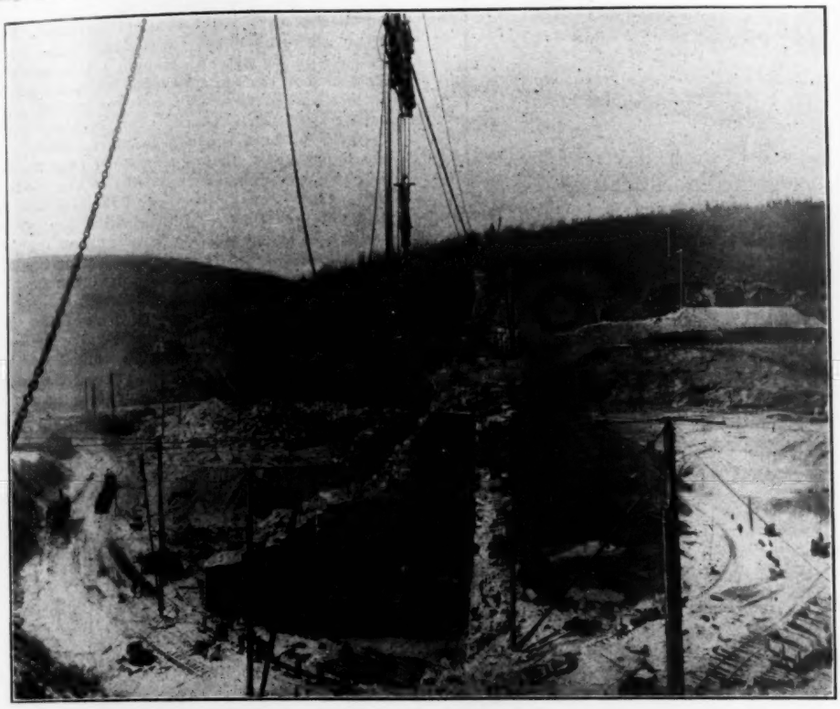

FIG. 3. VIEW OF MASONRY PORTION OF DAM, LOOKING NORTH.
(Shows Junction of Core-Wall of Earth Portion with Masonry Portion; Spillway Wall at the Right, in the Distance.)

"Decidedly in Favor of the Movement."

I believe the proposition of Mr. Carnegie to erect a building for the joint use of the principal engineering societies and the Engineers' Club is a most commendable one and will promote more friendly relations and a closer friendship among the members of the different societies. I am decidedly in favor of the movement. Yours truly,

Albany, N. Y., May 12, 1903. Chas. F. Stowell.

"The Proposed Location is Far More Convenient."

A Union Engineering Building has been my hope for ten years, and I most earnestly favor the American Society of Civil Engineers accepting Mr. Carnegie's magnificent offer. If our Society should be lukewarm or indifferent in generously co-operating, great harm will be done to its prestige. The proposed location is far more convenient for out-of-town members arriving early, waiting appointments or departing on midnight trains. The library, reading and conversation rooms will be utilized tenfold more and friendly acquaintance will be correspondingly developed.

John R. Freeman, Vice-President.

Providence, R. I., May 13, 1903.

"Favor Any Proposition Tending to Bring the Various Branches of the Engineering Profession into Close Harmony."

I am one of those who look with favor upon any proposition tending to bring the various branches of the Engineering Profession into closer harmony, and believe the standing and influence of the profession will be greatly strengthened by close coöperation in matters of general policy. I therefore, along with a large number of the younger members of the profession, am heartily in favor of the carrying out of the plan proposed by Mr. Carnegie, and believe that the American Society of Civil Engineers, as the real parent of the other societies, should take a foremost place in furthering a union among them all that never should have been broken in the first place.

Very truly yours,

Ithaca, N. Y., May 11, 1903. Gardner S. Williams.

A NEW PNEUMATIC HAMMER.

A new thing in pneumatic hammers is represented by a line of hammers just placed on the market by the Ingersoll-Sergeant Drill Co., of 26 Cortlandt St., New York, acting as selling agents for the Haeseler-Ingersoll Pneumatic Tool Co., of the same address. These hammers, which are the invention of Mr. C. H. Haeseler, General Manager of the latter concern, are called "Axial Valve" hammers, from the principal feature of their construction.

The general form and construction of an "Axial Valve" hammer is shown by Fig. 1, which shows a longitudinal section of the body of the tool. The air enters at the handle, as usual in such tools, and by an automatic valve is admitted alternately to the front and the back of the piston, thereby causing the latter to deliver a rapid succession of blows on the shank of the bit, which is inserted through the bushing at the front of the cylinder. Ordinarily in tools of this class a reciprocating piston or slide valve is used to govern the air passages. In place of the reciprocating valve the present tools have a large circular valve which oscillates about its axis through a small arc. This arrangement avoids all shock and possibility of erratic movement of the valve, makes it perfectly balanced in all positions, and ensures a minimum wear and consequent absence of leakage. The remarkably simple manner in which the whole valve with its casing can be removed and replaced is another factor in making the tool reliable and cheap in operation.

In Fig. 1 the valve-casing is shown in position between the cylinder and the handle. It receives the air at its upper end, and the valve contained in the casing distributes the air to the ports shown by full lines. The two ports shown by dotted lines take air from the cylinder back to the valve-casing for the purpose of moving the valve. The entire casing with its contained valve and cover is held in place by the abutting face of the cylinder, and, when the latter is unscrewed, may be removed by simply dropping it out. The proper position of the valve-casing relative to the cylinder is ensured by a dowel pin fixed to the casing.

The construction and relative arrangement of the valve and its casing are made clear by the view Fig. 2. To the right is shown the cover for the bottom of the casing, which is also guided by a dowel pin to its proper position on the casing. The end view of the valve shows its construction. A wing on either side can move in a slot cut in the casing; one of these wings is about double the length (radially) of the other one. These wings are the means by which the valve is moved. The wing shown to the left is constantly pressed in the direction of the arrow by compressed air from the supply passage, and thus tends to rotate the valve in a clockwise direction. The other wing may have air admitted below, and it then acts to turn the valve in an anticlockwise direction, since its larger area enables it to overcome the effect of the air pressure on the left-hand or shorter wing.

The arrangement of the air ports leading to the cylinder is such that when the valve is in the position shown in Fig. 2, it admits air to the cylinder above the piston, and this is the normal position of the valve. But when the piston has nearly reached the bottom or outer end of the cylinder it uncovers a port (see the dotted ports in Fig. 1), which admits air below the longer wing of the valve, and the valve is therefore moved anticlockwise as far as the slot in the casing will permit.

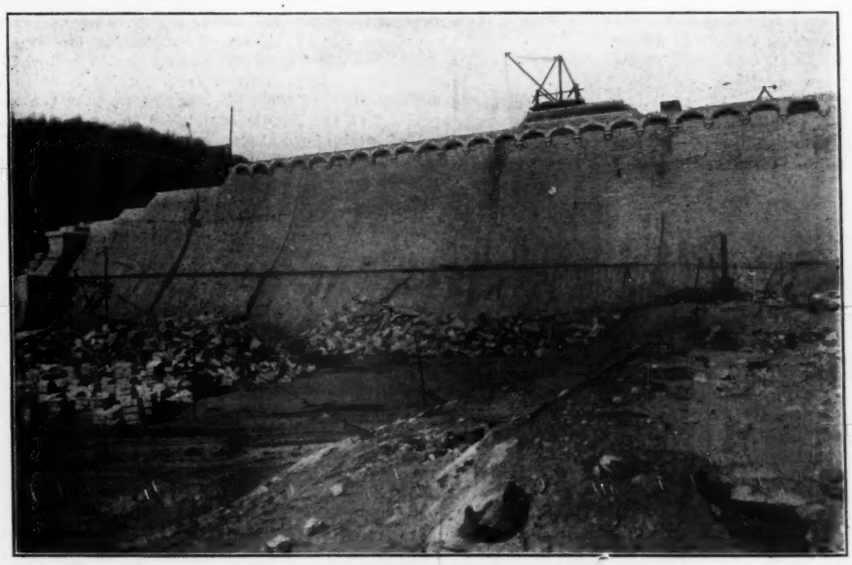

FIG. 4. A RECENT GENERAL VIEW OF THE ORIGINAL MASONRY PORTION OF THE NEW CROTON DAM.

The valve in this position admits air below the piston, while the space above the piston is connected to an exhaust passage, and consequently the piston is forced upward again. When the piston has nearly completed the upward stroke it uncovers an exhaust passage which releases the

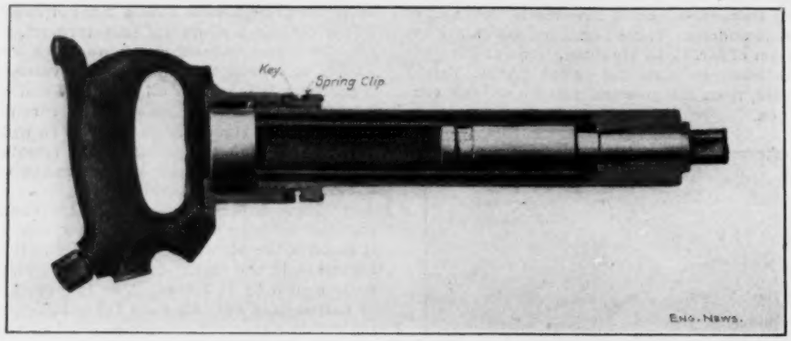

FIG. 1. SECTION OF "AXIAL VALVE" PNEUMATIC HAMMER.
The Haeseler-Ingersoll Pneumatic Tool Co., 26 Cortlandt St., New York, Makers.

air from the lower end of the cylinder and at the same time from the space below the longer wing of the valve. Since there is a constant air pressure against the shorter wing of the valve, the latter is at once moved back in clockwise direction to its normal position, when it again admits air above the piston, thus completing the cycle.

The operation is shown, more clearly than in the above description, by the diagram sections in Fig. 3. In these sections the valve is imagined to be turned 90° so as to come into the plane of the section. The position shown at A is the normal position of the valve, with the piston just beginning its downward stroke. The pressure against the shorter wing of the valve keeps it in the normal position until the piston reaches the position

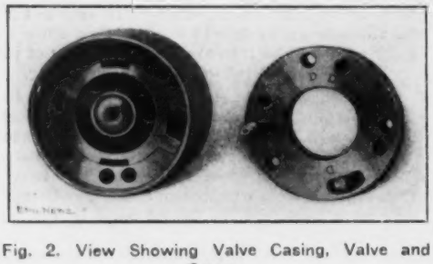

Fig. 2. View Showing Valve Casing, Valve and Cover.

shown at B, when air is admitted under the longer wing of the valve and turns it as shown, thereby exhausting the upper end of the cylinder and admitting air below the piston. The piston strikes a blow on the bit-shank at about the same time that the valve turns, so that it is ready to move back, as at C. At D the piston has returned far enough to exhaust the space below the longer wing of the valve, and the valve turns to normal position in time to cushion the piston and start it on another down stroke.

While the axial valve is the main feature of the new hammer, some of the other details are of novel design and merit attention. The manner of securing the valve-casing and valve in the space between handle and cylinder has already been referred to. It is obvious, however, that the cylinder must be screwed up so as to produce a tight joint against the valve-casing, since otherwise there will be leakage of air; and, further, the cylinder when once screwed up should be locked in position to prevent it from jarring loose in the operation of the tool. For this purpose the lower end of the handle is notched to form a number of teeth of equal size, as is shown best in Fig. 4; a collar formed on the cylinder in such a position as to come close up to the end of the handle when the parts are screwed together, is cut with similar notches spaced equidistant around its circumference, but so that their number is prime to the number of notches in the handle. Therefore, when the parts are screwed together only one pair of notches can coincide at any one time, but it will require only a very small angular change to bring another pair of notches into coincidence. Now, when the cylinder is screwed home, some pair of notches may always be brought into coincidence; a small steel key is then slipped into these notches to lock the parts against angular motion, and a spring steel clip is slipped over the collar on the cylinder to hold the key in place. The clip is notched slightly on one side to fit over the key, and the key is similarly notched in the middle of its length to engage the edge of the clip; both key and clip are thus held in position against any change of displacement. To disengage the parts it is only necessary to slip off the spring clip, take out the key, and unscrew the cylinder from the handle.

A special design of throttle-valve has been adopted in these hammers. The valve is located in the handle, as usual, and is actuated by a projecting trigger. The sectional view of the handle, Fig. 5, shows clearly the valve, trigger and air passages. These latter are all drilled out of the solid drop forging, the ends of the drill holes being subsequently plugged up. The valve is a simple poppet, held to its seat by the air pressure and opened by the trigger pressing downward on the valve-stem. It is returned to its seat by a light spring under the valve. A positive guide is given to the valve by a cylindrical enlargement on its stem sliding in a reamed hole. The trigger presses on the stem by an interposed steel ball, which ensures practical absence of wear and thereby maintains the throttle mechanism in its original tight condition. A removable screw plug in the handle in line with the valve-stem gives ready access to the valve and valve-seat for inspection or repair.

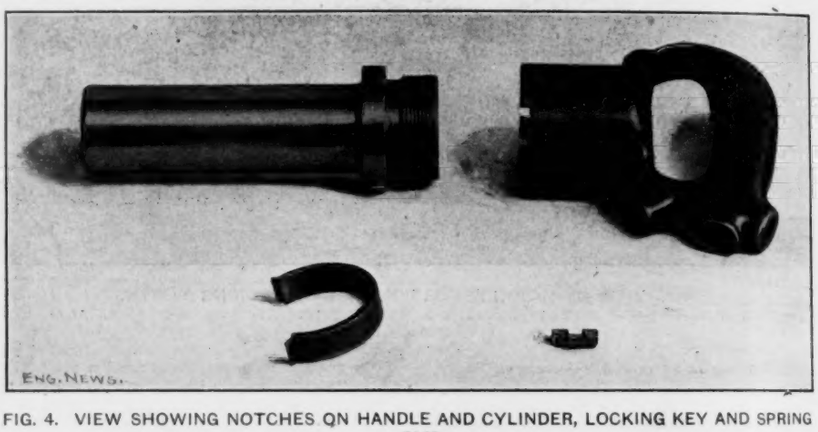

FIG. 4. VIEW SHOWING NOTCHES ON HANDLE AND CYLINDER, LOCKING KEY AND SPRING CLIP.

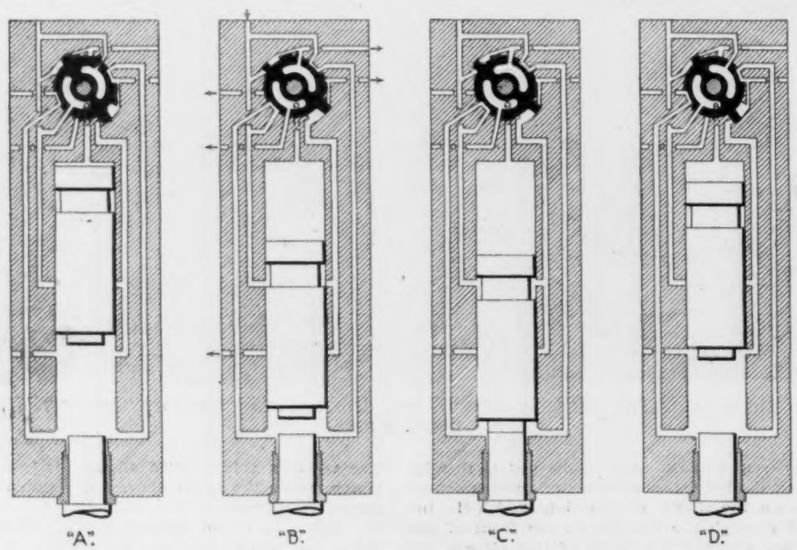

FIG. 3. DIAGRAMMATIC SECTIONS OF CYLINDER, VALVE, AND PORTS IN DIFFERENT PHASES.

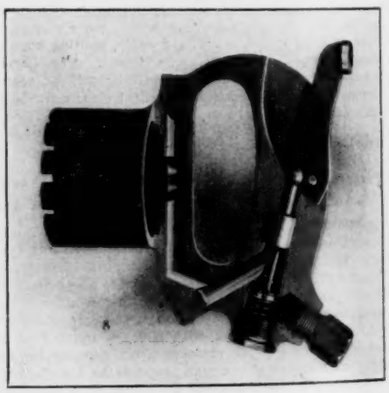

Fig. 5. Sectional View of Handle, Showing Throttle Valve and Trigger.

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